Liang Lee

Santa Clara Valley
Water District

PROBLEM DEFINITION AND REFINED OBJECTIVES REPORT

Lower Llagas Creek
Capacity Restoration Project

Project No. 50284010

CAPITAL PROGRAM SERVICES DIVISION

May 2010

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SANTA CLARA VALLEY WATER DISTRICT

LOWER LLAGAS CREEK
CAPACITY RESTORATION PROJECT
Project No. 50284010

PROBLEM DEFINITION AND REFINED OBJECTIVES REPORT

Report Prepared by:

Watersheds Capital Projects Division

Bal Ganjoo, P.E.	Senior Project Manager
Bill Springer, P.E.	Senior Engineer
Christy Chung, P.E.	Assistant Civil Engineer II

Coyote & Pajaro Watersheds Division

Liang Xu, Ph.D. P.E.	Senior Engineer

Watershed Stewardship Division

Carol Presley, P.E.	Senior Engineer
Tiffany Hernandez	Environmental Planner II
W. Doug Padley	Biologist III

Under the direction of:

Katherine Oven, P.E.
Deputy Operating Officer

C. Liang Lee, Ph.D. P.E.
Deputy Operating Officer

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EXECUTIVE SUMMARY

Flooding along Lower Llagas Creek (Pajaro River confluence to Highway 152) has been recorded since at least the mid-1800s. Individual farmers had dug ditches to drain their land, but in 1954 flooding was addressed regionally with the passage of the Watershed Protection and Flood Prevention Act (PL 83-566). Through the federal PL 566 program, construction on Reach 1 was completed in 1973, followed by Reach 2A in 1984, and Reach 2B in 1985. (See Fig. ES-1 on page ES-3.)

As the local project sponsor, the Santa Clara Valley Water District (District) was responsible for project maintenance. This maintenance work has included low-flow channel reestablishment and vegetation management. Since 1997, following the observation of a pair of least Bell's vireo, a federally-listed endangered species, channel maintenance has not been performed. Due to concerns that not removing sediment and vegetation from the channel has reduced the creek's ability to adequately convey flows, the District proposed this project to assess the flood risks and to determine remedial actions, if any, that are required.

The hydraulic analyses conducted to date for the project indicate that there is inadequate freeboard for 1.5 miles of Reach 2 (i.e., Reach 2A and part of Reach 2B), as well as some channel overtopping at the Miller Slough confluence. Reach 1 also does not have adequate freeboard, but instead of being protected from flooding, the area adjacent to Reach 1 should be allowed to flood as the Soap Lake Floodplain, according to the findings of the Pajaro River Watershed Study. Thus, to be consistent with the Soap Lake Floodplain preservation efforts, it is recommended that the original project objectives be modified to reflect that Reach 1 will not be remediated to the PL 566 design level. – To what level should it be kept at then ?

In 2000, the District conducted flood mapping to identify flooding sources for an internal study. The study concluded that the floodplain along Reaches 1 and 2 is actually comprised of a number of commingled floodplains originating from Llagas and Uvas Creeks and a number of their tributaries. Thus, flooding in the Lower Llagas Creek area is not solely attributable to the creek itself. Even if the creek's levees were raised to provide adequate freeboard, most of the adjacent land would still be in the regulatory floodplain because of flooding from Uvas Creek in the west and the Llagas Creek tributaries on the east. How should this fact affect objectives of this project?

A key consideration for flood protection efforts along Reach 2 is the presence of South County Regional Wastewater Authority (SCRWA) facilities: the wastewater treatment plant is located on the west side of the creek and percolation ponds are adjacent to the creek on both sides. All of the wastewater generated in Morgan Hill and Gilroy is processed by SCRWA. Another important consideration is the Upper Llagas Creek Flood Protection Project that is currently being planned by the District and the U. S. Army Corps of Engineers.

So is SCRWA affected by any of the flooding scenarios?

Preliminary geotechnical engineering investigations have determined that in general, the existing levees along the project reaches are in stable condition and there is no immediate threat to the structural integrity and safety of these levees. Additional geotechnical investigations, analyses, and levee evaluations may be necessary depending on the alternative selected.

In summary, the problems defined to date for this project are:

- Inadequate freeboard (0.2 to 3 feet) for 1.0 miles of Reach 2A, from 0.5 miles upstream of Bloomfield Avenue to Southside Drive.
- Inadequate freeboard (0.2 to 2 feet) for 0.5 miles of Reach 2B, from Southside Drive to 0.5 miles upstream of Southside Drive.
- Channel overtopping on the west bank at the Miller Slough confluence.

The objectives of the Lower Llagas Creek Capacity Restoration Project have been amended as follows:

- Evaluate the current flood risk in the area surrounding the project versus the design level flood risk.
- Develop options to provide flood protection for Lower Llagas Creek Reach 2 beyond the Soap Lake Floodplain in accordance with FEMA criteria.
- Identify ~~feasible opportunities~~ goals for environmental restoration and corridor preservation and future maintenance guidelines.

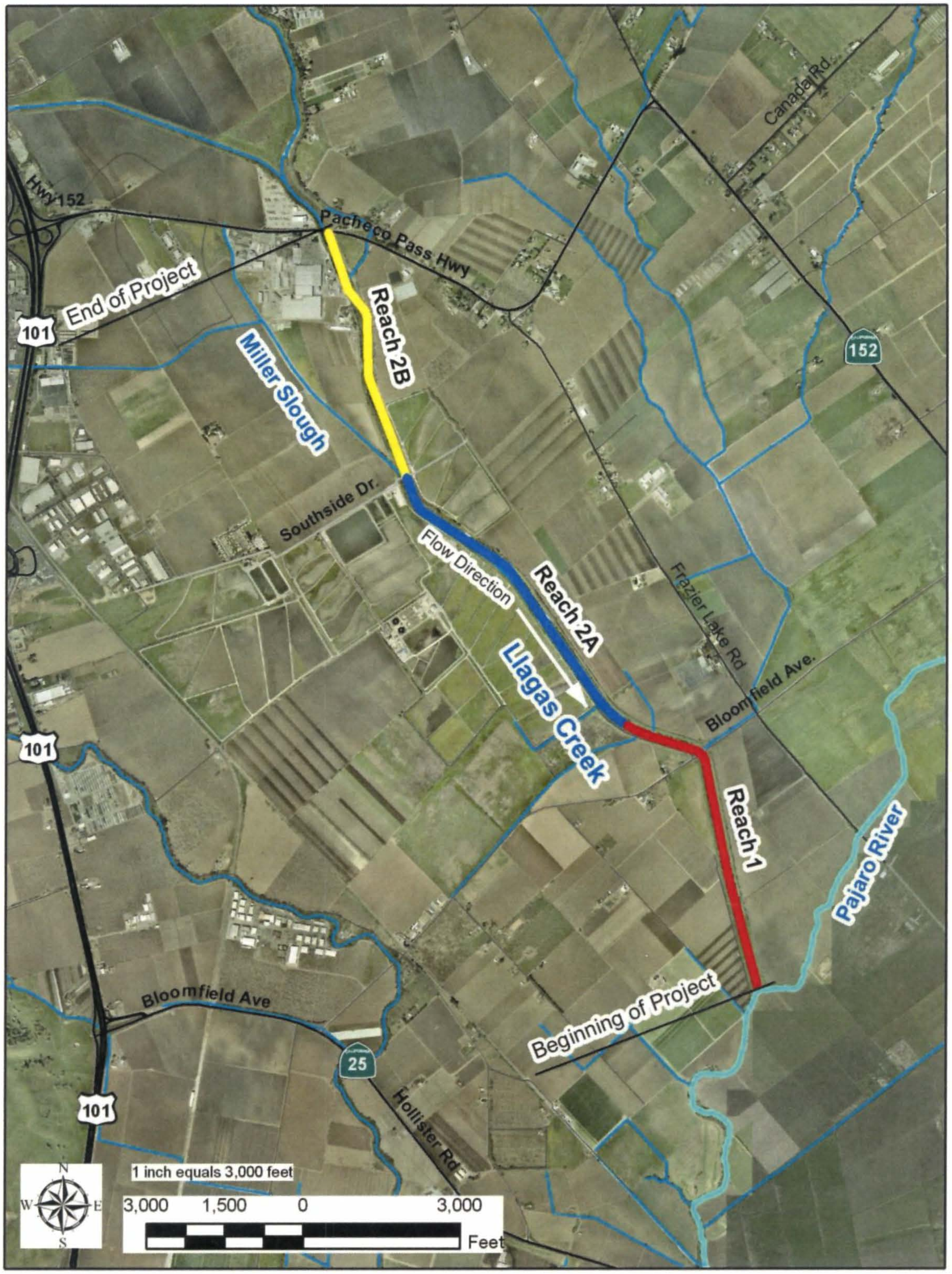

Figure ES-1. Lower Llagas Creek Project Boundaries

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1. INTRODUCTION

The Santa Clara Valley Water District (District) is conducting a Planning Study for the Lower Llagas Creek Capacity Restoration Project (Project). The purpose of this Problem Definition and Refined Objectives Report (PDR) is to describe the existing conditions of the project area, re-evaluate the project objectives defined in the Project Plan based on the knowledge gained by investigation and documentation of existing conditions, and refine these objectives as appropriate. This report was prepared using information from numerous published reports and studies, as well as discussions with the Project Owner and various District staff with knowledge of local conditions.

1.1. Location and Study Limits

Located in southern Santa Clara County, the Lower Llagas Creek Capacity Restoration Project focuses on 3.4 miles of Llagas Creek, from its confluence with the Pajaro River to Highway 152. This area corresponds to Reaches 1, 2A, and 2B of the Llagas Creek system. Figure 1-1 shows a regional watershed map. Figure 1-2 shows the project reaches.

1.2. Project Origin

Reaches 1, 2A, and 2B are engineered channels, constructed in 1973, 1984, and 1985, respectively. Planning, design, and construction were conducted under the auspices of what is known as the PL 566 program, funded by the federal Watershed Protection and Flood Prevention Act (PL 83-566) of 1954. As the local project sponsor, the District was responsible for maintenance of the project. This maintenance work has included low-flow channel reestablishment, vegetation maintenance, and motorgrading of maintenance roads.

In 1997, a pair of least Bell's vireo, a federally-listed endangered bird species, was observed in the project area. Since then, the channel maintenance described by the project's operations and maintenance (O&M) document has not been performed. Due to concerns that not removing sediment and vegetation from the channel has reduced the cross-sectional area of the creek and thus the creek's ability to adequately convey flood flows, the Coyote and Uvas/Llagas Watershed Division proposed that the Watershed Capital Division perform a study to assess the flood risk in Reaches 1 and 2 and determine what types of remedial action, if any, are necessary.

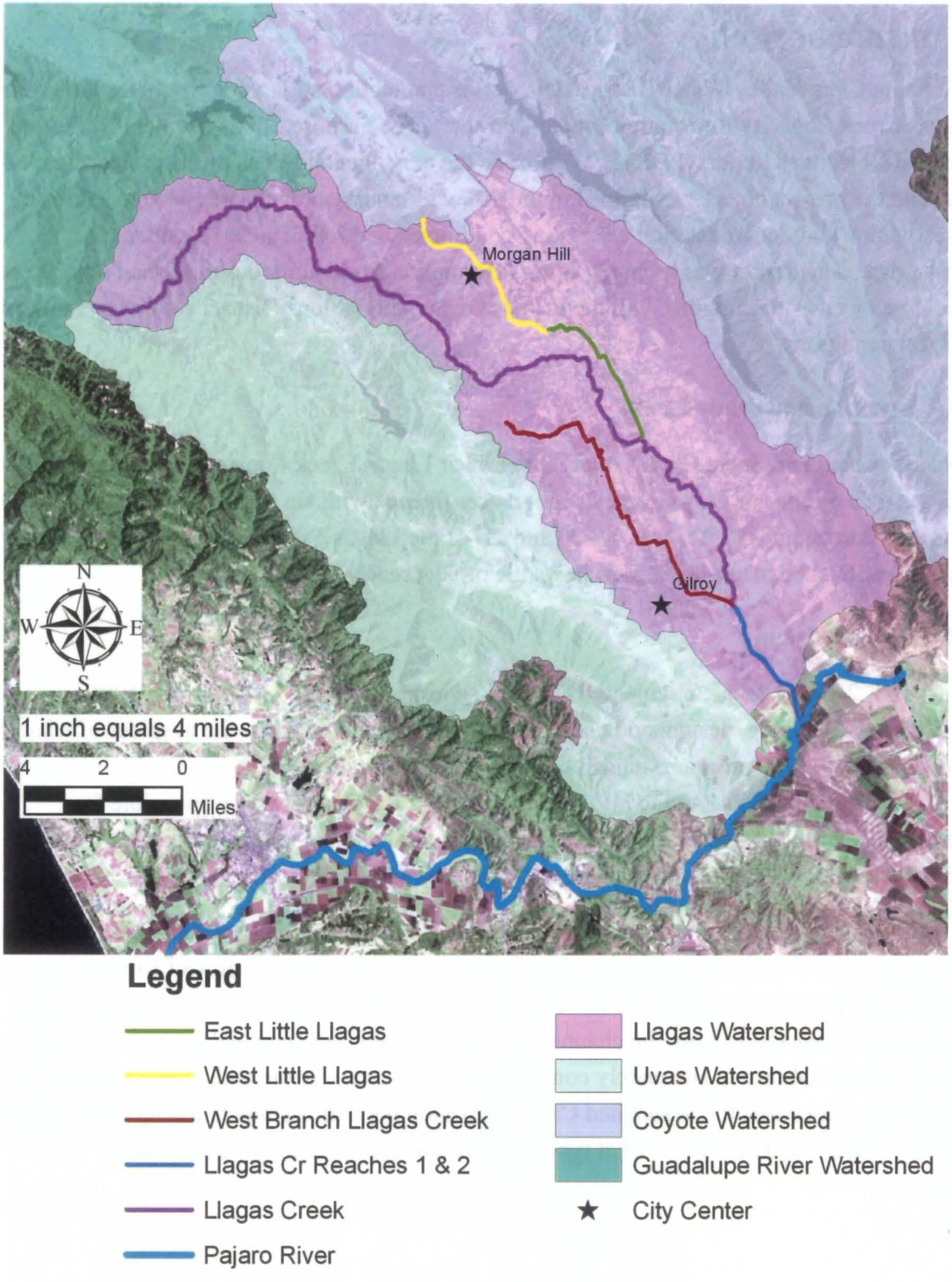

Figure 1-1. Llagas Creek Watershed

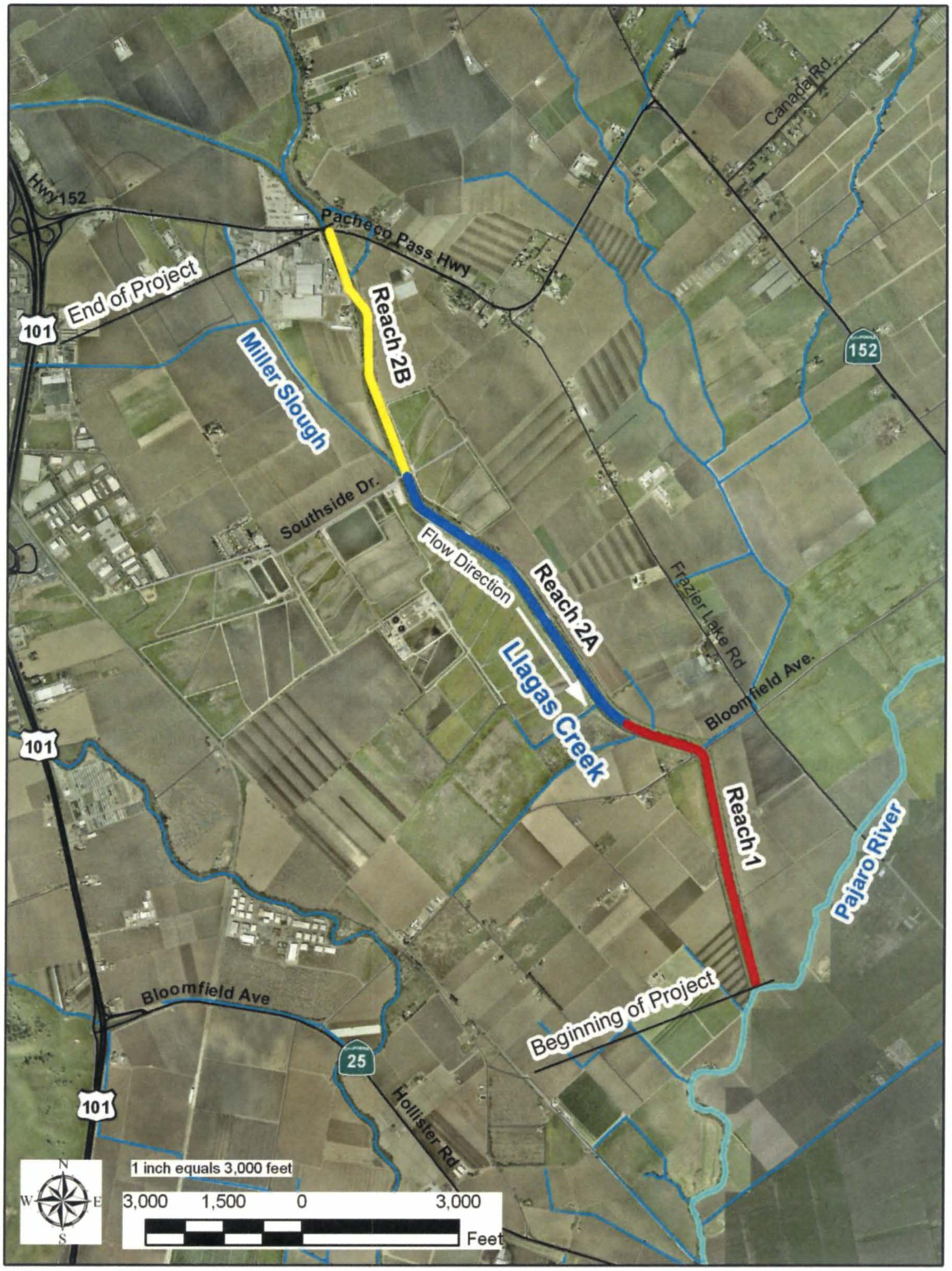

Figure 1-2. Lower Llagas Creek Project Boundaries

1.3. Project Objectives

As described in the Project Plan, this project will prepare a Planning Study for approximately 3.4 miles of Lower Llagas Creek, from the Pajaro River confluence to Highway 152, to accomplish the following objectives:

- Evaluate the current flood risk in the area surrounding the project versus the design level flood risk.
- Restore, at a minimum, the level of flood risk to that provided by the 1980s project in Lower Llagas Creek.
- Identify feasible opportunities for environmental restoration and corridor preservation and incorporate into solutions.

Natural Flood Protection (NFP) objectives will be used to guide the project toward achieving objectives listed above. The integration of the project's objectives with the NFP process is discussed later in this report.

1.4. Relevant Board Governance Policies

- Board Ends Policy E-3, Article 3.1.1: "Balance environmental quality and protection from flooding in a cost effective manner."
- Board Ends Policy E-3, Article 3.2.1: "Reduce flood risks in flood prone areas."
- Ends Policy E-4, Article 4.1.2: "Improve watersheds, streams, and natural resources."
- Ends Policy E-4, Article 4.3.1: "Support additional trails, parks and open space along creeks and in the watersheds when reasonable and appropriate."

2. STUDY BACKGROUND

2.1. Watershed Description

Llagas Creek extends approximately 30 miles from the confluence with the Pajaro River to Mount Loma Prieta in the Santa Cruz Mountains. The creek flows in a roughly southeasterly direction from Chesbro Reservoir, and draining portions of the cities of San Jose, Morgan Hill, and Gilroy, as well as unincorporated Santa Clara County. The Llagas Creek watershed has an area of approximately 90 square miles (SCVWD, 2009 hydrology, p. 1) that is both agricultural and residential. The watershed is bounded by the Uvas Creek watershed to the southwest and the Coyote Creek watershed to the northeast. The watershed receives an average annual rainfall ranging from 55 inches at the headwaters to 16 inches near the Pajaro River.

2.2. Previous Studies and Construction Projects

The Llagas Creek Flood Control Project was one of the projects funded by the Watershed Protection and Flood Prevention Act of 1954 (PL 83-566). Under the auspices of PL 566, Reaches 1, 2, 3, 9, 10, 11, 12, and 13 were designed and constructed through the joint efforts of the Soil Conservation Service (SCS, now the Natural Resources Conservation Service)[1] and local sponsoring agencies. Preliminary designs were developed for Reaches 4, 5, 6, 7, 8, and 14 but were not constructed.

Llagas Creek Flood Control Project, Reaches 1 and 2

Under the auspices of PL 566, Reaches 1 and 2 were designed and constructed through the joint efforts of the SCS and local sponsoring agencies:

- Santa Clara County Flood Control and Water District (in 1974 it was renamed Santa Clara Valley Water District)
- Loma Prieta Resource Conservation District
- South Santa Clara Valley Water Conservation District (in 1980 it was renamed Gavilan Water District and in 1987 it merged with Santa Clara Valley Water District)

Construction on Reaches 1, 2A, and 2B was completed in 1973, 1984, and 1985, respectively. The following were part of the PL 566 construction:

- Straightening of Llagas Creek: the old alignment curved around to the east and followed a portion of Holsclaw Road.
- Mitigation planting along the levee side slopes on outboard side for Reach 1 and inboard side, outboard side, and top of levee for portions of Reach 2.

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[1] The Soil Conservation Service, or SCS, changed its name to the Natural Resources Conservation Service, or NRCS, in 1994. For events that occurred before 1994, the old name will be used; for events that occurred in 1994 or later, the new name will be used.

- Construction of two grade control structures in Reach 2A and three grade control structures in Reach 2B.

Following the construction of Reach 1 in 1973, District engineers noticed that vegetation grew at a faster rate than they had anticipated. "Water from Pajaro River, combined with groundwater and water from the City of Gilroy's sewage treatment ponds" were all determined to be contributing factors to the "growth of a lush riparian habitat." Five years of vegetation growth in Reach 1 was estimated to have resulted in n-values ranging from 0.075 to 0.090, a substantial increase from the design n-value of 0.035. Thus, the target n-value was set at 0.063, assuming a certain level of future maintenance. (Wilson, pp. 1–3) In addition, during the planning for Reaches 2A and 2B, the increased vegetation growth was taken into consideration and the n-values were increased (Wilson, p. 1).

Llagas Creek Flood Control Project, Reach 3A

Llagas Creek Reach 3A extends from Highway 152 to Leavesley Road, which is about 2.2 miles. Construction on Reach 3A was completed in 1994; mitigation planting was completed in 1997 (SCVWD, 2006 financials, p. 3).

Upper Llagas Creek Project

Currently, the District and the U. S. Army Corps of Engineers (Corps) are working together to plan, design, and construct improvements on 13.6 miles of Upper Llagas Creek. Under the PL 566 reach number designation, this corresponds to Reaches 4, 5, 6, 7, 8, and 14—portions of Llagas Creek, West Little Llagas Creek, and East Little Llagas Creek. The State of California and the City of Morgan Hill are also contributing funding to the Upper Llagas Creek Project. Construction of the project would be completed by 2016 at the earliest.

Under the PL 566 program, the SCS was the federal agency leading the Upper Llagas Creek improvements. However, due to a decline in annual appropriations to the SCS which started in 1990, it wasn't able to make any progress on the Upper Llagas Creek improvements. Therefore, the District worked to have Congress transfer project authorization power to the Corps. This was accomplished through the Water Resources Development Act (WRDA) of 1999. (SCVWD, 2009 Project Plan, p. 1) After the Corps took over the project, it examined the NRCS design that was completed in 1995 and made some modifications based on current conditions (Corps, 2002). The proposed design contains a variety of elements, including: realigning and enlarging the channel; removing maintenance roads and grade control structures; replacing culverts; constructing gabions, floodwalls, channel diversions, grade control structures, levees (including setback levees), grade control structures, and pools and riffles; and installing vegetated riprap, vegetation plantings, and rootwad and boulder revetments.

Pajaro River Watershed Study

In October 1999, the Pajaro River Watershed Flood Prevention Authority (PRWFPA) was formed through a joint effort of four counties (Monterey, San Benito, Santa Clara, and Santa Cruz) and four water districts (Monterey County Water Resources Agency; San Benito County Water District; Santa Clara Valley Water District; and Santa Cruz County Flood Control and Water Conservation District, Zone 7). The PRWFPA initiated the Pajaro River Watershed Study in order to determine the causes of and solutions for flooding in the Pajaro River watershed. The key finding of the study was that the best solution to the watershed's persistent flooding problems is two-pronged: the downstream structural Lower Pajaro Levee Reconstruction Project and the upstream non-structural Soap Lake Floodplain Preservation Project.

The Lower Pajaro Levee Reconstruction Project will rebuild seven miles of levees of Lower Pajaro River, Salsipuedes Creek, and Corralitos Creek. The Soap Lake Floodplain Preservation Project seeks to preserve the natural flood storage functions of Soap Lake by funding land preservation projects using California Proposition 50 grant money. There is overlap between the Lower Llagas Creek Capacity Restoration Project and the Soap Lake Floodplain Preservation Project, since the 100-year Soap Lake Floodplain surrounds Reach 1 of Lower Llagas Creek. The Soap Lake Floodplain boundaries are shown in Figure 2-1.

South Santa Clara Valley Historical Ecology Study

In 2008, the San Francisco Estuary Institute (SFEI) produced the *South Santa Clara Valley Historical Ecology Study* for the District and The Nature Conservancy. This report presented maps and descriptions of the various habitat types found historically in south Santa Clara Valley, including Soap Lake, the Upper Pajaro River, and Llagas, Uvas-Carnadero, and Pacheco Creeks.

Santa Clara Valley Habitat Conservation Plan and Natural Community Conservation Plan (HCP)

The District is currently a partner in the development of a county-wide habitat conservation plan which covers approximately 520,000 acres, primarily within south Santa Clara County which will provide regulatory permission for certain activities that may impact sensitive species in the county. The other Local Partners are: the Cities of San Jose, Gilroy, and Morgan Hill; the County of Santa Clara; and the Santa Clara Valley Transportation Authority. Llagas Creek is identified in the Habitat Conservation Plan (HCP) as an area covered for in-channel activities. (Santa Clara Valley HCP/NCCP, p. 1)

California High-Speed Rail Project

In November 2008, California voters approved Proposition 1A, a $10 billion bond measure to provide funding for the construction of high-speed rail lines throughout the state. Of particular interest to the Project is the Morgan Hill-Gilroy Subsection of the San Jose to Merced

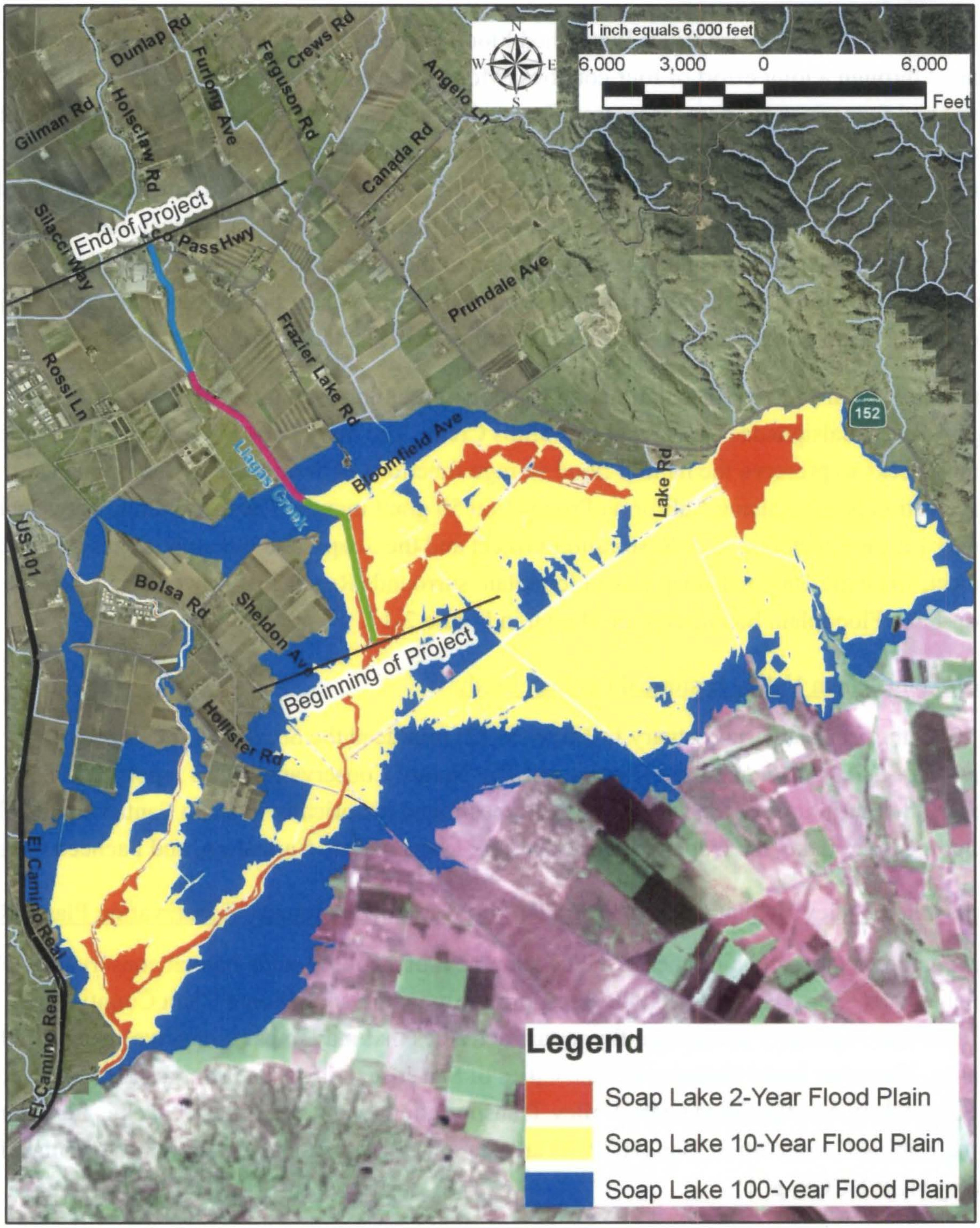

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Figure 2-1. Soap Lake Floodplain Boundaries

Section of the high-speed train system. The 30% preliminary engineering for the San Jose to Merced section is scheduled to be completed by Parsons in March 2012, and revenue service is projected to start in July 2019. Three of the alignment alternatives cross Project reaches: Gilroy Station Loop, East of UPRR to East Gilroy, and U. S. 101 to East Gilroy.

2.3. Creek Description

Lower Llagas Creek flows southward through a mix of agricultural and light industrial settings before entering into the Pajaro River. In Reaches 1 and 2, the creek is in a trapezoidal earth channel with a low-flow channel, levees, and flood benches. Both levee banks are vegetated through the project reaches. Features that are specific to each reach are described below.

Reach 1: Sta. 0+00 to 61+90, Pajaro River Confluence to 1,500 Feet Upstream of Bloomfield Avenue

Reach 1 contains both freshwater marsh and riparian woodland vegetation. A comparison of the as-built cross-section data with 2007 survey data (see Appendix G) indicates that from the Pajaro River confluence to about 3,300 feet upstream, there may have been some sedimentation and a migration of the low-flow channel from the center of the channel to the west toe of the channel.

The Bloomfield Avenue bridge was constructed by the County of Santa Clara in 1955 as a single span that measured 53.5 feet from abutment to abutment. In 1988 it was widened to 239 feet from abutment to abutment; the bridge structure is supported by five piers.

Reach 2A: Sta. 61+90 to 123+00, 1,500 Feet Upstream of Bloomfield Avenue to Upstream of Southside Drive

Reach 2A contains both freshwater marsh and riparian woodland vegetation. There are two grade control structures through this reach.

The Southside Drive bridge was constructed in 1985 by the District, and at that time it was known as the Luchessa Avenue Bridge.

Reach 2B: Sta. 123+00 to 177+10, Upstream of Southside Drive to Highway 152

There are three grade control structures in this reach. Instream vegetation is thick in this reach.

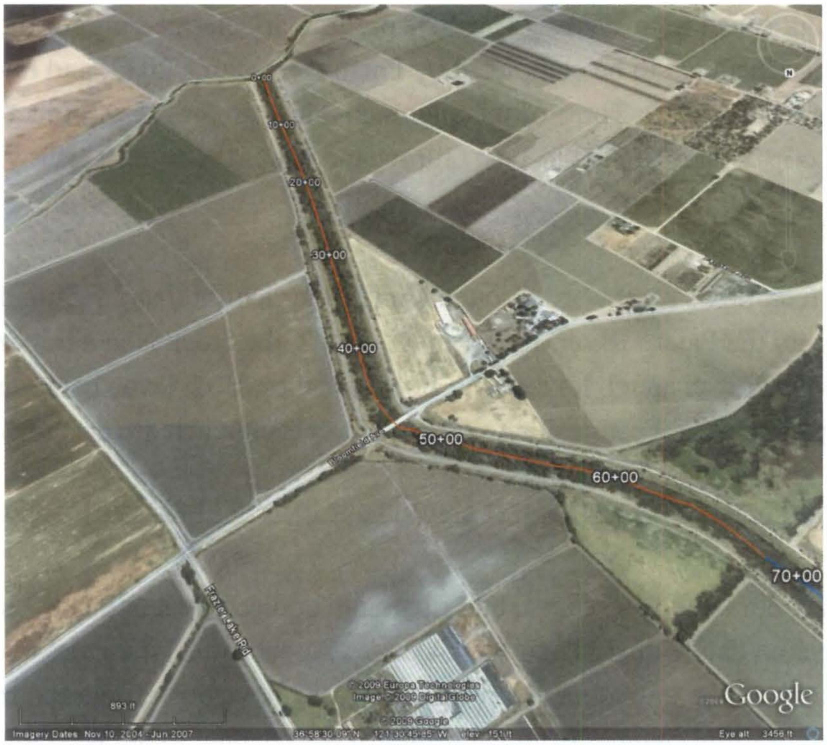

Photo 2-1. Aerial view of Reach 1 area (looking downstream)

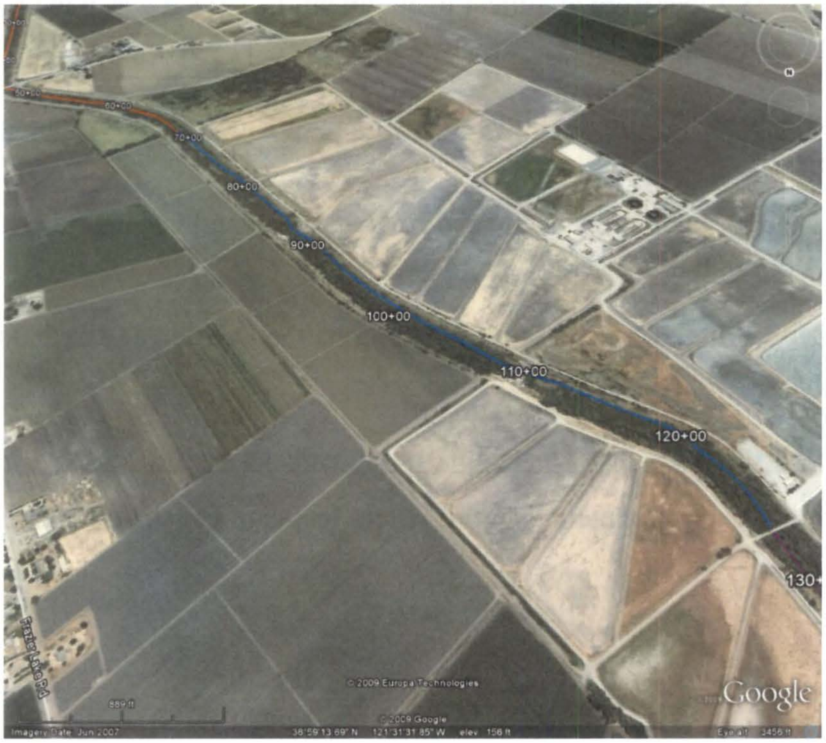

Photo 2-2. Aerial view of Reach 2A area (looking downstream)

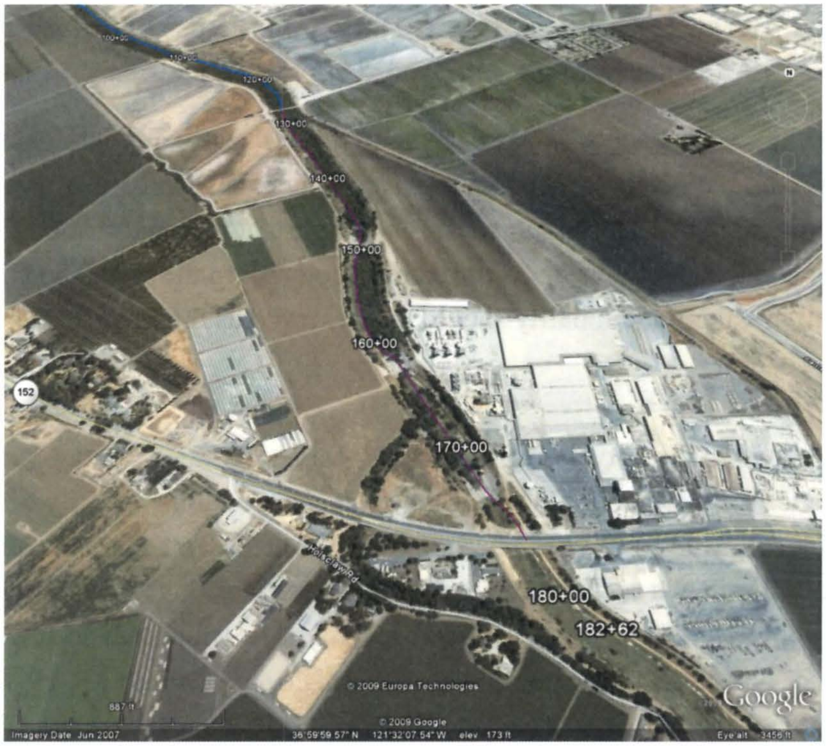

Photo 2-3. Aerial view of Reach 2B area (looking downstream)

2.4. History of Flooding

Most of the flooding on Llagas Creek has occurred upstream of the project area. However, there have been some recent recorded instances of flooding in the project area.

January 1997 Storm

In the January 26–27, 1997 storm, Llagas Creek flooded fields on both sides of Bloomfield Avenue; floodwaters were up to three feet deep in some locations (SCVWD, 1997 flooding, p. 6).

February 1998 Storm

In the February 2–9, 1998 storm, there was some ponding across Bloomfield Avenue about 500 feet away from Llagas Creek due to overflows from Jones Creek, which is a tributary of Llagas Creek (SCVWD, 1998 flooding report, Appendix A).

Soap Lake Floodplain

The drainage conditions in the project area have been conducive to the formation of seasonal lakes; the most prominent of those was "Pajaro Lake," now called Soap Lake. According to SFEI research, at the downstream end of Llagas Creek, a shallow seasonal lake was noted by surveyors starting in the mid-1800s. The greatest measured area of Pajaro Lake was documented in 1858 to be about 100 acres (SFEI, pp. 190–191). Over the course of the year, Pajaro Lake varied in area and typically disappeared from land surveyors' reports by the month of September.

Thus, historically, the Soap Lake area has been shown to be seasonally inundated by floodwaters. Based on the results of the Pajaro River Watershed Study, it is now known that Soap Lake is more than just a seasonal lake; it is an important regional feature that attenuates the movement of floodwaters, and thus helps to reduce flood risk in the watershed. The PRWFPA, has recommended that this functionality should be preserved as the Soap Lake Floodplain.

FEMA Flood Insurance Study

The project area is within the City of Gilroy and also unincorporated Santa Clara County. The first Flood Insurance Rate Maps (FIRMs) for the project area within the City of Gilroy were published in 1974, followed by the FIRMs for unincorporated Santa Clara County in 1978. In 1995, the District submitted a request for a Letter of Map Revision (LOMR) to reflect the flood protection work completed on Llagas Creek and several of its tributaries for PL 566. The FIRMs for both the City of Gilroy and the County were republished on August 17, 1998 to reflect the approved LOMR. However, area surrounding Reaches 1 and 2 was not removed from the 100-year floodplain due to flooding from sources that were not addressed by the PL 566 project.

On May 18, 2009, FEMA issued FIRMs in digital format (DFIRMs) that were seamless along city boundaries. These new maps use an aerial photo as a base map and the effective FIRM panels were digitized and aligned with the topography. The currently effective DFIRMs have not substantially changed since the 1998 study. As shown in Figure 2-2, virtually the entire study area is in the 100-year regulatory floodplain.

2000 District Flooding Source Mapping

In 2000, the District conducted flood mapping by flooding source for an internal study. These maps illustrated that the floodplain along Reaches 1 and 2 is actually comprised of a number of commingled floodplains originating from Llagas and Uvas Creeks and a number of their tributaries. These commingled floodplains are shown in Figure 2-3. Thus, flooding in the Lower Llagas Creek area is not solely attributable to the creek itself. Even if the creek's levees were raised to provide adequate freeboard, most of the adjacent land would still be in the regulatory floodplain because of flooding from Uvas Creek in the west and the Llagas Creek tributaries on the east.

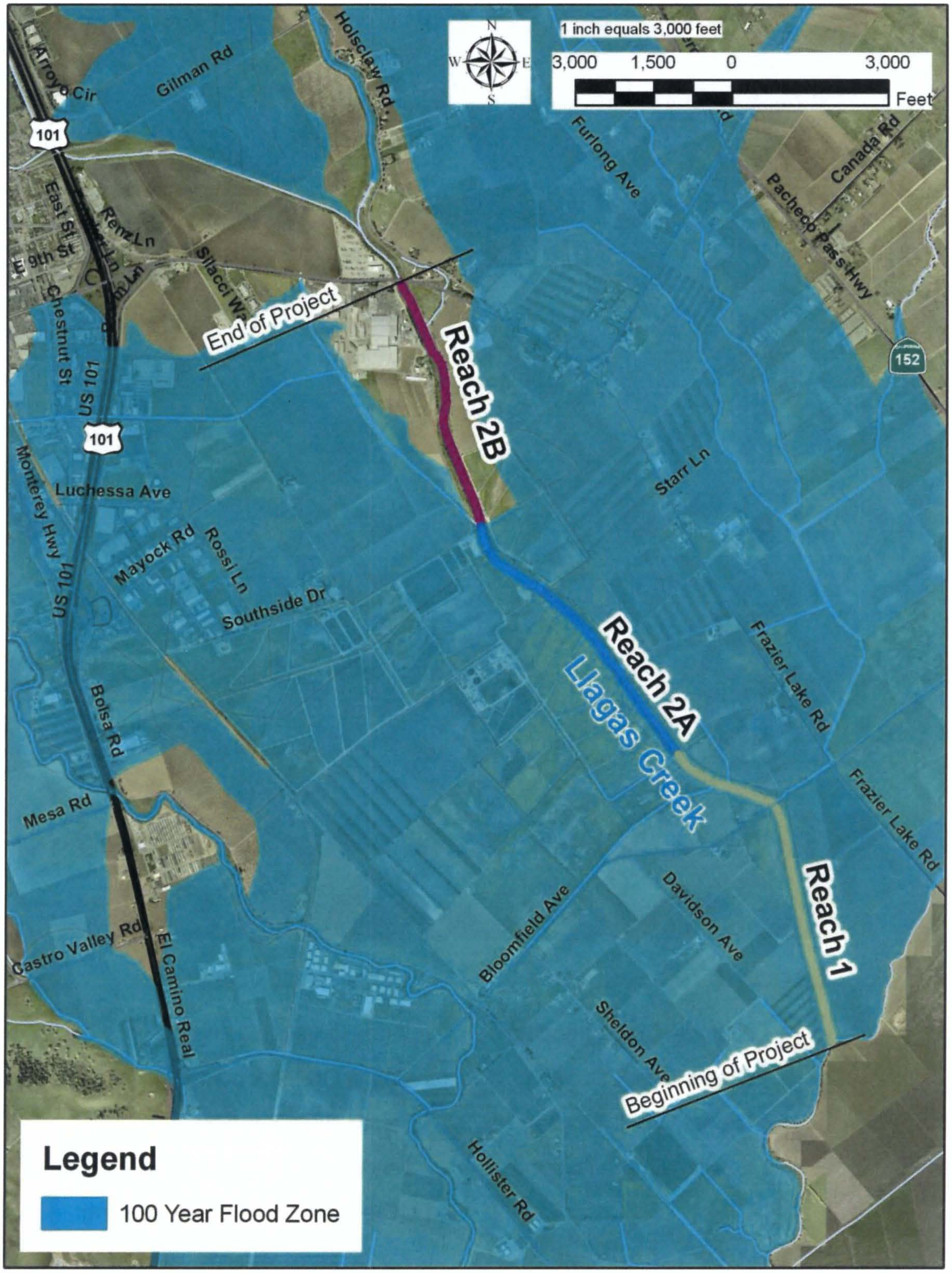

Figure 2-2. 2009 FIRM for Llagas Creek Vicinity

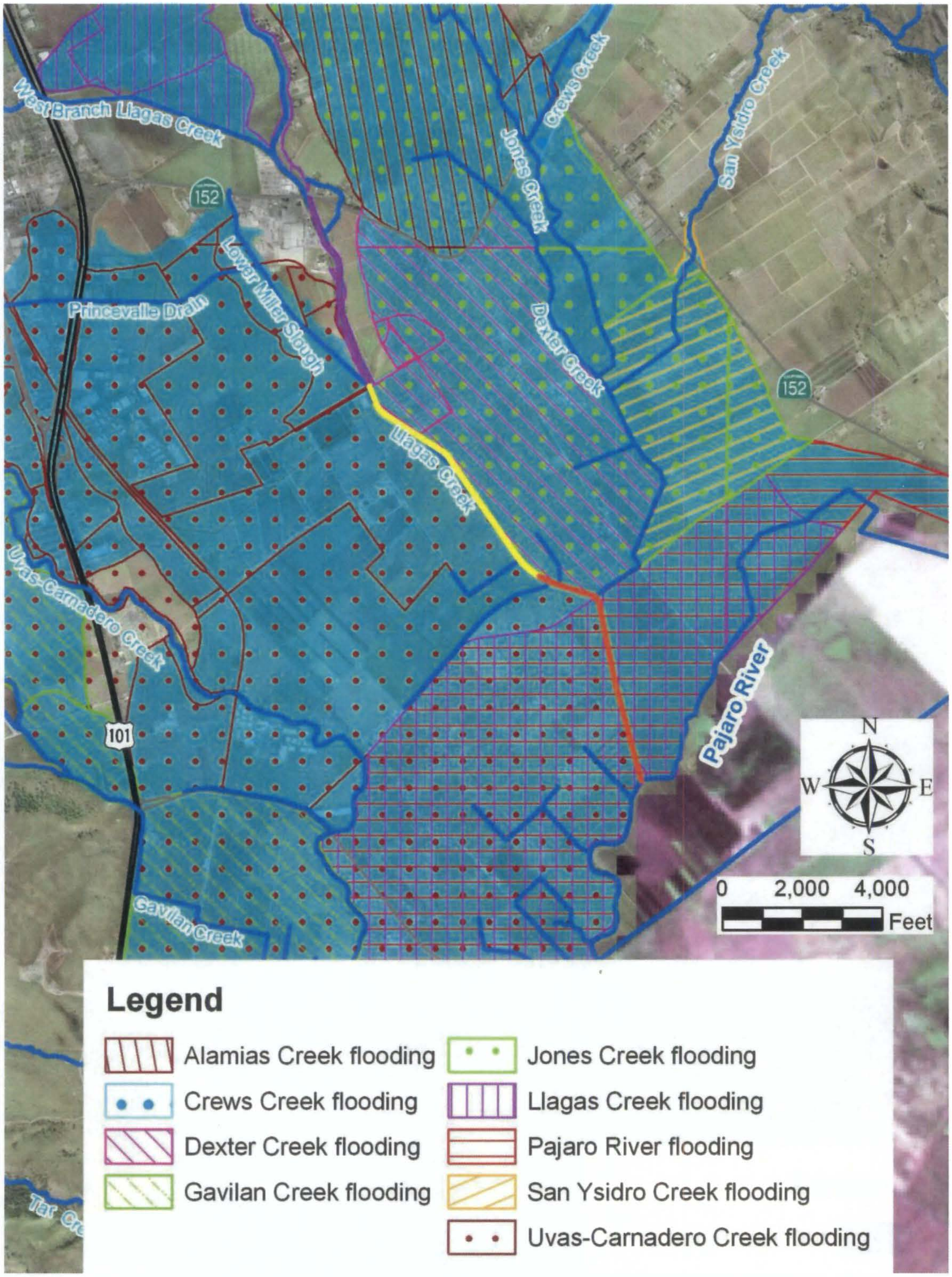

Figure 2-3. 2000 District Flood Mapping By Flooding Source

2.5. Hydrology

The SCS first performed a hydrology study in 1962 as part of the planning for the PL 566 flood protection project. Since then, the hydrology has been updated several times. In 2006, the Corps completed a hydrology study for the Upper Llagas Creek project, which included design flows for Lower Llagas Creek covering the project reaches. To remain consistent with the Corps, the District has decided to adopt the flowrates from this study for the project for Lower Llagas Creek. For additional background on the project hydrology, please refer to Appendix C, Creek Hydrology. The design flows for Llagas Creek are presented in Table 2-1.

Table 2-1. Design Flows for Llagas Creek

REACH	STATION FROM	STATION TO	2006 DESIGN FLOWRATE (CFS)	DESIGN FLOWRATE RETURN PERIOD	PL 566 DESIGN FLOWRATE (CFS)
1	0+00	27+80	9,500	10-YEAR	10,000
1	27+80	45+35	13,200	25-YEAR	14,300
1	45+35	61+90	16,000	50-YEAR	13,900
2A	61+90	88+80	18,800	100-YEAR	18,800
2A	88+80	126+60	18,800	100-YEAR	18,300
2B	126+60	129+40	18,500	100-YEAR	18,300
2B	129+40	177+10	18,500	100-YEAR	17,800

2.6. Groundwater Resources

Groundwater Basin Description

The project area is located in the Llagas groundwater subbasin.

> The Llagas Subbasin extends from Cochran Road, near Morgan Hill, south to the County's southern boundary. It is connected to the Bolsa Subbasin of the Gilroy-Hollister Valley Basin (DWR Basin Number 3-3) and bounded on the south by the Pajaro River (the Santa Clara - San Benito County line). The Llagas Subbasin is approximately 15 miles long, 3 miles wide along its northern boundary, and 6 miles wide along the Pajaro River. (District 2001). A series of interbedded clay layers, which extends north from the Pajaro River, divides this subbasin into confined and recharge zones. The subbasin serves multiple functions. It transmits water through the gravelly alluvial fans of streams into the deeper confined aquifer of the central part of the valley. It filters water, making it suitable for drinking and for municipal, industrial, and agricultural uses. Its storage capacity carries water from wet years to dry years, playing a critical role in water supply reliability. The groundwater subbasins provide all of the drinking water for the communities in South County, including Morgan Hill and Gilroy. In 2006, the Llagas Subbasin provided about 44 thousand acre-feet for agricultural and Municipal & Industrial (M&I) users (SCVWD, 2001 groundwater).

Groundwater Elevations

The project site is in the confined zone of the Llagas Subbasin, meaning that there is a thick accumulation of fine-grained silts and clay sediments in the area that can impede vertical flow of groundwater and create pressurized groundwater conditions in the lower aquifer, especially in the southern portion near the Pajaro River. Groundwater monitoring wells at the site are screened in the deeper aquifer materials, and the groundwater levels in these wells reflect the pressure of groundwater in the lower aquifer zone rather than the shallow unconfined aquifer.

Groundwater Wells

There are approximately 160 wells within 0.5 miles of Llagas Creek Reaches 1 and 2. In addition, there are nine groundwater monitoring wells within 0.5 miles of Llagas Creek Reaches 1 and 2. These wells are used to measure depth-to-water and water quality.

Groundwater Quality

Groundwater quality in the Llagas Subbasin is generally good, and much of the groundwater produced does not require treatment. Elevated nitrate from septic systems and agricultural practices remains a concern in the Llagas Subbasin, with concentrations in many private domestic wells approaching the California Department of Public Health Maximum Contaminant Level (MCL) of 45 mg/l. Another groundwater quality concern in the Llagas Subbasin is a perchlorate plume, which has impacted some wells in the Morgan Hill and San Martin area.

High Groundwater Level

The existing groundwater level in the downstream portion of the project is quite high. Farmers who own parcels along the east side of Reach 1, between Bloomfield Avenue and the Pajaro River confluence, cannot farm four to five months out of the year because the ground is too wet. Historically, according to SFEI:

> In spite of a drainage ditch of more than a mile in length that was constructed recently, the water table in this vicinity is usually within 3 feet of the surface during the drier part of the year, and during the rainy season the surface is inundated in places to a depth of 6 feet. Sedges and water-loving plants are the main vegetation, and two bodies of muck and peat have accumulated…a considerable tonnage of meadow grasses are cut for hay on the better drained spot. The greater part of this region can only be used for summer pasture for dairy cows. (SFEI, p. 189)

2.7. Geology

The project area is characterized by rather flat topography, inducing the creation of alluvial fans which have prevented flow from Lower Llagas Creek from freely discharging into the Pajaro River. The geology of the project vicinity was described as follows in the 1982 Llagas Creek Watershed EIR:

> The Llagas Creek Watershed is underlain by rocks of the Franciscan formation of the Jurassic and Cretaceous age. These rocks consist of a wide variety of lithologic types including sandstone, shale, and chert. Other sedimentary rocks present in small amounts are conglomerate and limestone. The sediments have been intruded by igneous bodies such as serpentine, periodotite, and diabase. Interbedded volcanics also occur. The Franciscan is exposed in the upper watershed on the west side of the valley. Also cropping out in this part of the watershed are several Tertiary and Cretaceous sedimentary units of relatively minor extent.
>
> The valley floor is a down-dropped block between uplifted mountains on either side. Quaternary alluvium has been deposited in the valley to depths up to 400 feet, and the total thickness of relatively unconsolidated sediments is probably in excess of 1,000 feet when the underlying Plio-Pleistocene deposits are included. Temporary damming of surface outflow from the valley caused in the periodic deposition of tight, clayey lake beds which are now aquicludes that confine several subsurface water bodies in the lower South Santa Clara Valley.

2.8. Biological Resources

Existing Vegetation Communities and Wildlife Habitats

Habitat associated with Lower Llagas Creek in Reaches 1 and 2 supports a matrix of cottonwood riparian woodland, willow riparian woodland, freshwater submergent, and freshwater emergent vegetation communities. Wetlands are also found outside the levees in both Reaches 1 and 2. The levees, and open space lands (grasslands and agricultural lands) may also be considered sensitive habitats in that they provide ecosystem support functions (foraging habitat) for species living within the Llagas Creek corridor.

Open space, including grasslands and shrubland habitats support species living within the riparian corridor. Grasslands are limited in the Llagas Creek project area to portions of the levees and a parcel (hay field) outside the levee downstream of Bloomfield Avenue. Agricultural lands border Llagas Creek throughout Reaches 1 and 2, and shrublands are limited to portions of the levee slopes. Industrial open space consists of the South County Regional Wastewater Authority (SCRWA) percolation ponds. These lands provide foraging habitat for birds such as white-tailed kites, red tailed hawks, northern harriers, and song sparrows which nest within the riparian corridor. The industrial open space also provides foraging habitat for pied-billed grebes, American coots, mallards, and green-backed herons, which may nest in the wetlands within Llagas Creek.

Outside of the creek levees, the adjacent lands are agricultural lands planted in row crops, pasture, and hay, as well and heavy industrial lands, including public infrastructure.

Llagas Creek Reaches 1 and 2 provide habitat with multi-layer vegetation components for a number of sensitive and non-sensitive species. The value of the habitat extends beyond the channel itself and provides ecosystem services for the surrounding agricultural lands. In addition to resident or nesting birds, the habitats in Llagas Creek may be a migratory rest stop for species moving through the San Francisco Bay area. Here birds can pause during their migration, feed on the abundant resources and then continue their migration.

Sensitive Species

Habitat in Llagas Creek could support several sensitive species including the endangered least Bell's vireo and threatened South-Central California steelhead trout, both of which are federally-listed species. Additionally threatened California red-legged frog and California tiger salamander could also be present. These listed species, and any projects which may affect them, fall under the jurisdiction of the federal Endangered Species Act of 1973 (Act) as amended.

No sensitive plant species are known to occur within Llagas Creek. However, sensitive plant species were identified in the South County area and may be present on the Llagas Creek or within the footprint of future alternatives. As project alternatives are further refined, potential impacts to these sensitive species and sensitive habitats will be evaluated in more detail.

Least Bell's Vireo

Habitat in the project reaches can support this endangered bird species. Least Bell's vireos were observed nesting on Llagas Creek in Reach 2 in 1997. The District initiated follow-up surveys to confirm the presence of this endangered species and to identify the habitat used by the species and continue to survey on an annual basis. Between 1997 and 2002 the survey methods and locations were standardized and the surveys were repeated annually through 2004 and again in 2006. Additional sightings of least Bell's vireos were made in 2001, but no nesting activity was confirmed. In 2006, a least Bell's vireo was heard singing, but this location was not confirmed by other biologists.

Presence of the vireo and the associated habitat have restricted the ability of the district to conduct regular maintenance activities, including vegetation removal, in the project area due to the lack of appropriate regulatory permissions. The US Fish and Wildlife Service has documented that the there is a potential for routine maintenance or construction activities to impact the species and its habitat. Any alternative selected for this project will require consultation and approval from the US Fish and Wildlife Service and the California Department of Fish and Game. Additionally, the vireo is currently included in the county wide Habitat Conservation Plan (HCP) being developed for local agencies in an effort to get incidental take authority for several sensitive species. Reach 1 and 2 of Llagas Creek are part of the HCP coverage area.

South-Central California Steelhead Trout

Steelhead trout utilize the Pajaro River system, including Llagas Creek. Available habitat for spawning and rearing of steelhead is limited to upper reaches of Llagas Creek. Conditions in the creek are heavily modified due to urbanization and in-stream barriers. It is expected that the proposed project area which includes Reaches 1 and 2 is used a migration corridor for adults entering the system and juveniles leaving the system. Reaches 1 and 2 do not currently support rearing or spawning for steelhead due to habitat conditions. Presence of steelhead in Llagas Creek can limit the timing of in-channel maintenance or construction activities. Any alternative will require consultation and approval from the National Marine Fisheries Service and the California Department of Fish and Game.

Historical Ecological Setting

In 2008, SFEI produced the *South Santa Clara Valley Historical Ecology Study* for the District and The Nature Conservancy. This report presented research showing that prior to Euro-American modification in the Gilroy area, the land adjacent to the project area consisted of a variety of land cover types:

- Reach 1: Seasonal lake/pond, alkali meadow (low concentration), wet meadow, and grassland.
- Reach 2: Willow grove, valley freshwater marsh, and freshwater pond.

Wetlands

According to SFEI, the combination of alluvial fans from tributary creeks and natural levees along Llagas Creek created “lowlands (that) lay along both sides of the present Llagas Creek position, forming long wetland strands stretching for several miles.” In addition, a “lobe of Carnadero Creek’s alluvial sediment blocked Miller Slough-lower Llagas Creek’s drainage into the Pajaro River, causing even more extensive wetlands to form.” (SFEI, p. 185)

What is currently called Soap Lake was once called Pajaro Lake:

> On the flat, low land around Old Gilroy, Llagas Creek spread into a shallow, poorly-defined channel, then into multiple channels traversing the marshy areas. These channels drained through the large willow grove at the bottom of Llagas Creek into “Pajaro Lake” (Day 1854), a large, seasonal lake connecting the bottom of the Llagas with the head of the Pajaro River (SFEI, pp. 186–187).

Old Gilroy was located near present-day Highway 152, east of the current creek alignment.

Willow Thicket

Historically, there was always thick willow growth along Lower Llagas Creek:

> To the east of the perennial freshwater wetlands, around the current location of the lower Llagas Creek channel, a vast willow grove (approximately 280-320 ha/700-800 ac) extended from Old Gilroy (just south of Pacheco Pass Road, and east of the modern Llagas Creek channel) south past Bloomfield Avenue. The northernmost extent of the willow grove is just below Pacheco Pass Road, indicating that this segment of the road was constructed to circumvent the northern edge of the willow grove (SFEI, p. 189)

2.9. Cultural Resources

The project may require areas to be excavated to improve flood capacity. Prior to construction potential impacts to cultural resources will be evaluated through database searches and site investigations if needed. If historical or pre-historic resources are found or if there is a high potential to encounter these resources, approaches will be developed to avoid or minimize those potential impacts.

2.10. Hazardous Materials

A Limited Phase I Hazardous Substance Liability Assessment (HSLA) report was prepared for the project by Light, Air & Space Construction (LAS). The purpose of the Limited Phase I HSLA is to identify recognized environmental conditions (RECs) associated with the subject site due to both onsite and offsite sources before property acquisition and to protect the District from the financial liability and legal responsibility for the cleanup of contaminated property upon acquisition of the property. With regard to recognized environmental conditions in connection with the Lower Llagas Creek Corridor, the study concluded the following:

- The closed Gilroy Landfill located at 1500 Southside Drive is a recognized environmental concern that may contain soil and/or groundwater contaminants.
- There is a shooting range containing spent lead bullets that is adjacent to the landfill, but it is not considered to be a recognized environmental concern.
- There is currently no specific evidence at adjoining properties that would indicate the likelihood of environmental impairment to the Lower Llagas Creek Corridor.
- There is currently no visual evidence of hazardous-material contamination, indications of improper hazardous material storage or disposal, or identified significant concerns relating to ACM, LBP, PCBs, USTs and ASTs in or adjacent to the Lower Llagas Creek Corridor.
- Given the documented historic use (1880s to the present) of the adjacent properties for agricultural uses including orchards, vineyards, row crops, grain crops and cattle grazing, and the periodic flooding of the adjacent agricultural properties, there is a possibility of

residual concentrations of herbicides, pesticides, and fertilizers in the soils adjacent to the creek banks and the sediments within the creek channel.

The study recommended that prior to conducting any subsurface excavation of soils as part of the Lower Llagas Creek Capacity Restoration Project, soil data should be obtained. If structures are to be demolished, samples should be taken to determine if they contain any regulated substances.

2.11. Utilities

Based on the as-built drawings for the PL 566 project, there are 19 outfalls along the Project and an irrigation line along Bloomfield Avenue. Further investigation into the utilities present along the creek will be conducted. The relocation, protection, or avoidance of existing utilities could have a significant impact on work in or around the creek.

2.12. Community Facilities in the Neighborhood

South County Regional Wastewater Authority

The South County Regional Wastewater Authority (SCRWA) was created in 1992 through a joint powers agreement between the Cities of Gilroy and Morgan Hill. Built in 1994, the SCRWA wastewater treatment plant (WWTP) treats all of the wastewater from the Cities of Gilroy and Morgan Hill. The WWTP has an 8.5 MGD (millions of gallons per day) processing capacity during dry weather and an 11 MGD capacity during wet weather. SCRWA is planning to expand the treatment capacity to meet the future demand.

SCRWA percolation ponds are adjacent to Llagas Creek on both sides of the creek. On the west side of the creek, SCRWA owns about 960 acres of land. On the east side of the creek, SCRWA owns about 120 acres of land. Not all of the SCRWA land is used for percolation ponds. Some land is used as a buffer between the treatment plant and its neighbors, and some land is being leased to Obata Farms, which uses recycled water for irrigation.

For the South County Recycled Water System, SCRWA is the recycled water producer, the District is the recycled water wholesaler, and the City of Gilroy is the recycled water retailer. In 1999, the District formalized its partnership with SCRWA and the Cities of Gilroy and Morgan Hill to plan and operate the recycled water distribution system in South County. SCRWA and the District are considering the use of the treated water from the treatment plant for streamflow augmentation.

In early 2009, SCRWA completed the planning and design for the South Pipeline Project, a wet weather discharge pipeline that would run south from the WWTP to the Pajaro River and discharge tertiary-treated water into the river when effluent flow volumes exceed storage capacity at the plant. The engineering design for the pipeline included five turnouts specified by the District to enable the delivery of recycled water to users along the pipeline. The estimated cost for constructing the five turnouts was $150,000. With this investment, the recycled water delivery in South County could be expected to increase by approximately 30%. The project was ready to go out to bid in 2009, but the City of Gilroy decided to put the project on hold indefinitely due to citywide financial difficulties. SCRWA and the District are actively pursuing grant funding to help fund this project.

Gilroy Foods & Flavors

Gilroy Foods & Flavors, a subsidiary of ConAgra Foods, Inc. has a processing facility on the west side of Llagas Creek at Highway 152.

Calpine Power Plants

Calpine operates two power plants west of Llagas Creek at Highway 152. Both plants use recycled water for their cooling towers.

The Gilroy Cogeneration Plant is a gas-fired cogeneration facility. It was constructed and operated by Bechtel Corporation until 1996, when it was acquired by Calpine. The cogeneration plant produces electricity that is sold to PG&E. Using the waste heat that is generated from electricity production, the plant also produces and sells thermal (steam) energy to a thermal host, Gilroy Foods and Flavors.

Calpine coordinated and managed the construction of the Gilroy Energy Center. This energy facility only operates during times of peak demand to prevent blackouts. Calpine is under contract with the Department of Water Resources to provide power to the State of California during times of peak electricity demand.

3. EXISTING CONDITIONS AND PROBLEM DEFINITION

Nearly 25 years have passed since construction on Lower Llagas Creek was completed; it has been more than ten years since vegetation was last removed from the creek and its levees. Since the District was a partner in improving Lower Llagas Creek through the PL 566 program, the effect of this lack of maintenance must be assessed. The Coyote and Uvas/Llagas Watershed Division has an interest in determining the current flood conveyance capacity of the creek, whether this still meets the PL 566 design level of flood protection, and what should be done to provide an adequate level of flood protection. Any solutions to the problem should also consider opportunities for environmental restoration and corridor preservation, as has been specified by the Project Owner.

3.1. Water Quality

The California Regional Water Quality Control Board (Water Board) is responsible for protecting water resources from pollution and nuisance that may occur as a result of waste discharges. The Central Coast Regional Water Quality Control Board (Region 3) has jurisdiction over the Pajaro Watershed. A TMDL is the loading capacity for a given pollutant that a water body can accept while protecting beneficial uses. The Clean Water Act requires a Total Maximum Daily Load (TMDL) be developed to restore impaired water bodies to their full beneficial uses.

A Sediment TMDL for the Pajaro River, including Llagas Creek, Rider Creek, and the San Benito River, was established by resolution of the Central Coast Regional Water Quality Control Board (RWQCB) on Dec. 2, 2005. The numeric targets established for the Sediment TMDL for the Pajaro River watershed are targets, not water quality objectives. They are meant to express the goals of the Central Coast RWQCB to eventually achieve through improved land management and restoration. Landowners, land managers, and the public should view the numeric targets as guideposts which serve to assist groups in evaluating the success of their work.

A Nitrate TMDL for the Pajaro River and Llagas Creek was established by resolution of the Central Coast RWQCB on December 2, 2005. The Nitrate TMDL for Pajaro River and Llagas Creek is set at a maximum concentration of 10 mg/l nitrate-N in receiving water to protect the MUN (municipal and domestic supply) beneficial use. Nitrate sources in the Pajaro River and Llagas Creek watersheds were generally classified as emanating from: agricultural land use, urban land use, and open space. The RWQCB concludes that the primary source of nitrates to Pajaro River and Llagas Creek is croplands, the rationale being that elevated nitrate levels were found adjacent to croplands.

A Proposed Resolution to amend the Water Quality Control Plan for the Central Coast Basin to add a TMDL for Fecal Coliform in the Pajaro River Watershed was prepared by Central Coast RWQCB staff on March 20, 2009. The proposed basin plan amendment also includes provision of a Domestic Animal Waste Discharge Prohibition and a Human Fecal Material Discharge Prohibition applicable to the Pajaro River Watershed. The beneficial use of water contact recreation is not being attained in Pajaro River Watershed because fecal coliform concentrations exceed Basin Plan numeric water quality objectives protecting this beneficial use.

The water quality problems in Llagas Creek associated with sediment, nitrate, and fecal coliform in excess of the Water Board TMDLs may be addressed through Project improvements.

3.2. Flood Risk

The 100-year flood is defined as a flood that has a one-percent (1%) probability of occurrence in any given year. The 100-year flood does not necessarily happen once in a hundred years; it can occur in consecutive years or even twice in the same year. The original PL 566 project provided 100-year flood protection in Reaches 2A and 2B, but not Reach 1, as shown in Table 2-1. It is unclear why different levels of flood protection were specified, but it appears that this was because "agricultural" and "urban" areas were treated differently. Agricultural areas were designated to be protected from at least the 10 percent event; urban areas were designed for 1 percent flood protection (Andreuccetti, p. 57).

HEC-RAS Model Development

A steady flow HEC-RAS model was developed using the following data sources:

- Geometry developed from District topographic surveys performed in 2007, using both LiDAR and field survey methods
- Bridge data from the 2007 survey and subsequent field observations
- Construction as-builts from the PL 566 project
- Manning's "n" values assigned according to field observations
- 2006 U. S. Army Corps of Engineers Upper Llagas Creek Hydrology (which included design flowrates for the Lower Llagas Creek project reaches)
- PL 566 design flood frequency
- Downstream boundary condition based on the Soap Lake Floodplain elevations from the Pajaro River Watershed Study

Soap Lake Floodplain / Boundary Conditions

The Soap Lake HEC-RAS model output from the Pajaro River Watershed Study was used to determine the appropriate the boundary conditions for the Project hydraulic modeling. The model includes both Llagas Creek and Pajaro River, and the boundary condition for the Project is the water surface elevation on the Pajaro River that Lower Llagas Creek discharges to. The boundary conditions were determined to be as shown in Table 3-1.

Table 3-1. Boundary Conditions

Return Period (years)	Pajaro River Water Surface Elevation at Llagas Creek Confluence (ft NAVD88)
2	143.6
10	145.6
25	147.2
50	148.8
100	149.7

Freeboard Analysis

According to the Project Plan, the Project Owner has specified that FEMA freeboard criteria be used for the Project, instead of either the original SCS design criteria or the District standard. Since the creek water surface is higher than the adjacent ground from Sta. 0+00 to 157+00 (Reaches 1, 2A, and more than ½ of 2B, levee freeboard policy governs this section. FEMA freeboard policy is as follows:

- Where the design water surface is above natural ground:
    - Leveed sections: 3 feet
    - Upstream end of leveed sections: 3.5 feet
    - Leveed sections within 100 feet of a bridge: 4 feet

The hydraulic analyses conducted thus far indicate that there is inadequate freeboard for all of Reach 1 and 1.5 miles of Reach 2 (i.e., Reach 2A and part of 2B), as well as some overtopping at the Miller Slough confluence. The existing conditions freeboard calculations are shown in Appendix D. Alignment with the PRWFPA's findings that the Soap Lake Floodplain should be preserved removes the need to provide flood protection to the areas within the 100-year Soap Lake Floodplain, which extends from Sta. 0+00 to 75+00 (Reach 1 and 1,300 ft of Reach 2A) on Lower Llagas Creek.

The Project's proximity to the South County Regional Wastewater Authority facilities, which require protection from flooding, as well as its connection to the Upper Llagas Creek Flood Protection Project, which requires consideration of the future condition of Lower Llagas, will be factors in the future refinement of the project and are not treated here.

3.3. Maintenance

The O&M agreement with the SCS signed by the District in 1982 and revised in 1984 had a general plan in place for maintenance field inspections and corrective actions if necessary. The 1984 revision initiated by the District was agreed to in 1985 and included the following actions:

- Grouted riprap: Maintained and cleaned.
- Channels: Inspected with regard to erosion, sedimentation, vegetation growth, and accumulation of trash and debris. Maintained to as-built conditions.
- Earth Embankments: Maintain vegetative cover, control/prevent animal burrowing.
- Maintenance Roads: Maintained at all times to facilitate inspection and maintenance work.
- Rock Slope Protection: Maintained to as-built condition.
- Vegetative Erosion Control Planting: Maintained to as-built conditions, fertilizer applied annually. Mowing if necessary, carried out per guidelines.
- Woody Plantings: Maintained to as-built conditions, fertilizer applied annually. Weeding if necessary, carried out per guidelines.
- Local Drainage Inlets: Maintained to be serviceable.
- Fencing: Maintained to as-built conditions.

Over the years, minimal maintenance has been done on this portion of Llagas Creek. There were three types of work that was performed:

- Low flow channel reestablishment (1986, 1988, 1993)
- Vegetation maintenance (hand labor)
- Motorgrading maintenance roads

In 1997, the federally-listed endangered least Bell's vireo was observed on Lower Llagas Creek. Since then, no maintenance work has been done on Lower Llagas Creek, since the District and the NRCS did not obtain the necessary environmental clearances. Any maintenance activity that impacts least Bell's vireo habitat will likely be closely scrutinized by the resource agencies.

3.4. Erosion and Sedimentation

Erosion was not observed to be a concern in Lower Llagas Creek. Heavily vegetated channel side slopes and floodplain, as well as the flat channel slope, appear to provide protection against erosion.

Sedimentation has occurred in the downstream portion of Lower Llagas Creek, as shown by a comparison of the PL 566 as-built cross-sections and the 2007 LiDAR cross-sections. However, since this aggradation seems to end about 1,400 feet downstream of Bloomfield Avenue, sedimentation is not considered to be a problem for the project.

3.5. Local Drainage

As researched by the San Francisco Estuary Institute (SFEI), the project area has a history of local drainage problems due to its low, flat topography and alluvial sediment deposits from Carnadero Creek, which blocked the outflow of runoff and groundwater. These conditions encouraged the creation of tule swamp over "many hundred acres" (SFEI, p. 187).

Before the PL 566 project was constructed, the downstream-most 3.5 miles of Llagas Creek (which encompasses the entire project area) were observed to be "poorly defined and flood-prone." In the 1880s, farmers saw that the soil was very fertile and "especially valuable for gardening purposes." But in order to farm the land, it needed to be drained, and by the 1890s, "extensive ditch systems were in place in the Bloomfield Road/Pacheco Pass Road region east of Gilroy to drain this land." (SFEI, p. 187) Drainage ditch systems remain in place today.

It will be necessary to work with these drainage conditions in developing project alternatives. In the Soap Lake Floodplain area, the poor drainage conditions could contribute to favorable conditions for habitat improvement by providing a natural water source.

3.6. Levee Design and Construction

The levees were typically designed with 2:1 (horizontal:vertical) slopes having a semi-compacted or compacted central core and a two-foot-thick outer shell with un-compacted loose fill. The loose fill on the outer shell was apparently placed for growing plants and vegetation. However, the compaction specifications for the central core of the levees typically called for 90 percent relative compaction based on the ASTM D698 standard, which results in lower compaction of levee fill than the current ASTM D1557 standard.

Based on a geotechnical engineering review of the levee design and site visits, it is concluded that the existing levees along the reaches are in generally stable condition. There is no immediate threat to the structural integrity and safety of these levees. It appears that the levee fill and its foundation soils have consolidated over the years, and have become stronger with time. The shape and structure of the levees appear to be intact except for some minor cracks, bulging, and sloughing of levee slopes in the creation area. Periodic maintenance work will be required to maintain the levees' current flood protection capability. For a more detailed discussion on the levee evaluations, please refer to Appendix E.

The design and construction records from the project file indicate that these levees would not satisfy the current FEMA requirements for levee certification. Additional geotechnical investigations, analyses, and levee evaluation would be necessary for FEMA certification. However, levee certification would only become an issue if the land adjacent to Lower Llagas Creek were to be taken out of the floodplain. Since this would require flood protection projects on several nearby creeks, it is not likely that levee certification would be pursued for the levees on Lower Llagas Creek.

It is uncertain as to whether or not the existing levees would be able to support additional weight. Additional geotechnical investigations would be necessary if levee raising were to be considered as a project alternative.

3.7. Problem Definition

The key problems identified in the existing conditions assessment are:

- Inadequate freeboard (0.2 to 3 feet) for 1.0 miles of Reach 2A, from 0.5 miles upstream of Bloomfield Avenue to Southside Drive.
- Inadequate freeboard (0.2 to 2 feet) for 0.5 miles of Reach 2B, from Southside Drive to 0.5 miles upstream of Southside Drive.
- Channel overtopping on the west bank at the Miller Slough confluence.

4. OPPORTUNITIES AND CONSTRAINTS

For the purpose of this report, an opportunity is defined as either:

- A specific benefit that can be directly achieved through implementation of the project; or
- A potential enhancement or other planned or future project by other entities in the area that contributes to the overall interest of the community.

4.1. Environmental Restoration Opportunities

The Lower Llagas Creek Capacity Restoration Project presents the District with opportunities to correct deficiencies in existing facilities while restoring historical habitats and enhancing wildlife corridors. Potential environmental restoration opportunities were identified based on information contained in the existing reports and the recommendations of project biological staff. The opportunities for enhancement are consistent with the natural flood protection objectives established for the project.

Relevant Board Policies

The Governance Policies of the District's Board of Directors were revised in December 2009. These changes included the Ends Policies, as well as the corresponding CEO Interpretations. Under Ends Policy 4.1.2, "Improve watersheds, streams, and natural resources," there are three relevant Implementing Measures (IMs) in the CEO Interpretation:

- **IM4.1.2a**: Identify environmental enhancement opportunities to the Board and list habitat goals that may be achieved by the project.
- **IM4.1.2b**: Identify to the Board, potential integrated environmental enhancement opportunities which do not exceed $25,000 in estimated construction costs. Identification should occur early in the planning phase of capital projects for consideration to include in the design and construction.
- **IM4.1.2c**: Evaluate independent environmental enhancement opportunities including an assessment of anticipated ecological benefits for consideration of implementation.

As part of the updated Board policies adopted by the Board in December 2009, staff has defined the following terms:

- "'**environmental enhancement**': Action taken by the District that benefits the environment, is NOT mitigation, and is undertaken voluntarily. Enhancement actions may include environmental restoration, rehabilitation, preservation or creation. In instances where enhancements are located in the same vicinity as a mitigation project, actions must exceed required compliance to compensate for environmental impacts to be considered environmental enhancements."
- "'**integrated environmental enhancements**': Actions considered minor that are integral to the primary objectives of a flood protection or water supply project (e.g., channel widening to allow for additional vegetation within district right-of-way)."

- "'**independent environmental enhancements**': Actions that could be designed and implemented as a stand-alone project"
- "' **restoration**': Action taken by the District, to the extent practicable, toward the re-establishment of an ecosystem's pre-disturbance structure, function, and value, where it has been degraded, damaged, or otherwise destroyed."

Due to the Board policies as stated above, restoration opportunities may not be integrated into the project solution because the restoration opportunities identified thus far would exceed $25,000 in construction costs. Thus, these restoration opportunities will be presented as independent environmental enhancements.

Restoration of Historical Habitats

The *South Santa Clara Valley Historical Ecology Study* (*Historical Ecology Study*) describes a willow woodland, ephemeral pool, and wet meadows along the lower reaches of Llagas Creek. The Project has the potential to restore a portion of each of these habitats along Lower Llagas Creek. Areas immediately adjacent to the Pajaro River between Llagas Creek and Frazier Lake Road may be suitable for establishment of wet meadow habitats. High groundwater and limited overland drainage (Soap Lake) provide two of the physical characteristics needed for the development of wet meadow habitats. Vegetation or fire management may be necessary to reduce or prevent encroachment of willow woodlands or tules into this area.

Upstream of the wet meadows, in the vicinity of Bloomfield Avenue, the *Historical Ecology Study* identified a shallow, open water seasonal pond that may have been ringed with tules. Alternatives that release water onto the lands between Frazier Lake Road and Llagas Creek may be suitable for re-creation of this seasonal pond habitat. A seasonal pond may be suitable for reproduction by California red-legged frogs and California tiger salamanders.

The primary area for willow woodlands identified in the *Historical Ecology Study* was in the vicinity of Llagas Creek between Bloomfield Avenue and Highway 152. Portions of the SCRWA site have accidentally developed as willow woodland. Additional sites on either side of Llagas Creek could be restored to willow woodland. Willow woodlands with a wetland mix and expansion of the existing willow riparian corridor may create suitable habitat for a variety of sensitive species.

Water Quality Improvement through Buffering Vegetation

Buffer strips can have multiple benefits to a stream restoration project, especially one located adjacent to agricultural fields, like the Lower Llagas Creek project is. Buffer strips can act as filters for pollutants from agricultural runoff, as well as providing habitat for birds, insects, and other wildlife, which promotes biodiversity.

Dependent upon details of land acquisition opportunities, the project could consider vegetation installation for water quality improvement. Installation of vegetative buffer strips is consistent with the recommended strategies of the *Pajaro River Watershed Water Quality Management Plan* prepared for the association of Monterey Bay Area Governments in June 1999 and also with recommendations presented in *the Monterey National Marine Sanctuary Water Quality Protection Program's Action Plan for Agriculture and Rural Lands* (1999). Vegetative buffer strips are also identified in the *Pajaro River Watershed Integrated Regional Water Management Plan* (2007) as part of its comprehensive Agricultural Water Quality Program.

Improvement of Fish Habitat

Restoration of the Llagas Creek floodplain, the creation of seasonally inundated wet meadows, and creation of ponds hydraulically connected to groundwater may create conditions suitable for the reintroduction of native fish. Sacramento Blackfish, Sacramento Perch, and Tule Perch were identified as fish species historically found in Llagas Creek.

Creation of Bird Nesting Habitats

Creation of bird nesting habitats can be accomplished by restoring adjacent land to wet meadows, willow woodlands, and open water habitats. Additional nesting habitats can be created by creating nesting islands within the open water habitats and wet meadow habitats described above.

4.2. Cost-Saving Opportunities and Efficiencies

Form Partnerships with Other Organizations

Other agencies and organizations in the County are interested in the preservation of open space and habitat. Solutions to identified problems could involve both activities. Given the current economic climate, it is prudent to collaborate with others and form cost-sharing agreements for mutual benefit. Possibilities for partnerships could exist with:

- The Nature Conservancy
- Pajaro River Flood Prevention Authority
- Santa Clara County Open Space Authority

Align with Soap Lake Floodplain EIR

The PRWFPA has already demonstrated that preserving the Soap Lake Floodplain has benefits related to the alleviation of flood risk for the lower Pajaro River in Santa Cruz and Monterey Counties. The findings are presented in the FPA document, *Soap Lake Floodplain Preservation Project Final Initial Study and Negative Declaration, (March 2005).* It will be important to review this document and remain consistent with its findings.

Secure Grant Funding and State Subventions

To fund the project, it may be possible to secure grants and/or state subventions (for Lands, Easements, Relocations, Right of Way, and Disposal Sites—LERRDs).

Soap Lake Floodplain Preservation Project

The PRWFPA has developed a grant program funded by a $4 million California Proposition 50 grant. The District, three other flood control agencies, and the four county governments which contain the Pajaro Watershed, are members of the Authority. Approximately $3.5 million is available in matching funds for the acquisition of land rights for the purpose of preserving land within the Soap Lake Floodplain. The Soap Lake Preservation Project is designed to preserve the natural floodplain characteristics through the acquisition of land and flood conservation easements. If the land in the Soap Lake Floodplain were to be developed, the existing natural flood storage characteristics would be eliminated and flood flows would increase downstream. It is estimated that loss of the Soap Lake Floodplain would increase the 100-year peak flow from 44,000 cfs to 60,000 cfs at the Chittenden Gap, which is located proximal to the county border between Santa Clara and Santa Cruz.

The PRWFPA's grant program is intended to be a cooperative effort between the PRWFPA, county and city agencies, private organizations, and local landowners. The PRWFPA may award grants to local governments, private nonprofit 501(c)(3) organizations focused on land conservation, and private landowners interested in preserving the flood characteristics of their property.

Clean, Safe Creeks

An amount of $250,000 in Clean, Safe Creeks funding was set aside for acquiring right-of-way in the Soap Lake Floodplain. It is possible that these funds could be used for acquiring right-of-way that is both in the Lower Llagas Creek overbank area and the Soap Lake Floodplain.

County-Wide Habitat Conservation Plan (HCP)

The District is currently a partner in the development of a county-wide habitat conservation plan which will provide regulatory permission for certain activities that may impact sensitive species in the county. Llagas Creek is identified in the Habitat Plan as an area covered for in-channel activities. Additionally, the least Bell's vireo and south-central California steelhead trout are currently identified as species associated with Llagas Creek that will be evaluated for incidental take authorization through the Habitat Plan. Depending on the timing associated with completion and approval of the Habitat Plan and the project planning and design, individual agency consultations may not be required as project activities and impacts could be authorized in the final Habitat Plan.

4.3. Constraints

A constraint is defined as anything which may place a limit, restriction, or barrier to planning, design, and/or implementation of the project. Constraints are described in terms of how they may limit a project.

Available Right-of-Way

The District owns only the creek corridor. Alternatives that require land outside of the levees would require acquisition of such lands. In addition, the SCRWA facilities on the both sides of the creek in Reach 2 are a constraint.

Available Permits for Channel Maintenance

Since Lower Llagas Creek is not included in the ten-year Stream Maintenance Program permit, instream vegetation management work is more difficult to undertake. Additionally, the USFWS has identified these reaches as endangered species habitat for least Bell's vireo. Any work in the channel associated with the project will require consultation with state and federal agencies. Potential impacts to the habitat will need to be evaluated before channel maintenance or other activities in the project area can proceed.

Available Stream Gage Data

Currently, there are no streamflow data from U. S. Geological Survey (USGS) gage 11153650 (SCVWD Alert ID 2086) that can be used to validate the HEC-RAS models. In the past, the gage was calibrated for flows only up to 200 cfs due to a lack of vegetation maintenance in the channel near the gaging weir. Vegetation maintenance at the gage was conducted in December 2009. There must be a large storm event to obtain the high-flow gaging information that is necessary for calibrating the HEC-RAS models. While the lack of data does not prevent the project from going forward, it is a constraint on the confidence of the engineering design and assumptions of channel roughness for the project.

Long-Term Maintenance Requirements

It will be important to consider life-cycle costs when evaluating alternatives. As a result of this project, the following maintenance activities may be required: vegetation management, erosion repair, and stream gage maintenance. After the operations and maintenance plan for the project has been determined, the project team will work to have these activities added to the District's Stream Maintenance Program.

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5. POLICIES AND REGULATIONS

5.1. Santa Clara Valley Water District

District Resolution 82-30

On May 25, 1982, the District Board of Directors adopted a resolution that stated:

> …it shall be the policy of this District that it shall neither make nor permit any use whatever for public access for park, trail, recreation or similar purposes of lands presently owned or acquired by it for the Upper and Lower Llagas Creek PL 566 Watershed projects while adjacent lands are within the areas designated as "Resource Conservation Areas" in the land use plan of the General Plan of the County of Santa Clara.

The May 2008 Land Use Plan that is based on the 1995 Santa Clara County General Plan shows that from the Pajaro River confluence to Sta. 157+00, the parcels on both sides of Llagas Creek that are not part of SCRWA are designated as Resource Conservation Areas, of the subtype Agriculture Large Scale. Thus, there can be no trails or other recreational features along the creek in this area. District Policy and Procedure 1-425 discusses this in more detail.

Natural Flood Protection

The project incorporates the District's Clean, Safe Creeks and Natural Flood Protection (NFP) Program Objectives using WW75125—Guidance on Alternative Evaluation and Selection for Natural Flood Protection Projects. There are two distinct steps to developing project-specific weights for the nine objectives.

First, initial relative weights (high, medium, low or not applicable) for each of the nine objectives are set by the project team in cooperation with the Project Owner. The initial NFP objective weights shown in Table 5-1 were developed via discussions and meetings with the Project Owner in February 2009.

Table 5-1. NFP Objective Weights

No.	Natural Flood Protection Objective	Weight
1	Provide protection from flood damage	High
2	Support ecological functions and processes	High
3	Integrate physical stream functions and processes	High
4	Minimize maintenance requirements	High
5	Integrate within the context of the watershed	High
6	Protect the quality and availability of water	Medium
7	Cooperate with other agencies to achieve mutually beneficial goals	High
8	Maximize community benefits beyond flood protection	Medium
9	Minimize life-cycle costs	Medium

Second, the initial relative weights are refined by the community being served, through project-specific advisory committees, community meetings, and local agency meetings, as appropriate. Internal and external Subject Matter Experts (SMEs) can also provide information to refine the NFP objectives and develop success criteria. These success criteria are used in the development and refining of feasible alternatives.

The team shall revisit and refine the NFP objective weights with both the appropriate internal staff and external stakeholders during the feasible alternatives phase of the project. The NFP objectives, in combination with the overall project objectives, will be used to develop and refine the conceptual and feasible alternatives. During this process, the conceptual alternatives will be winnowed down to a smaller set of feasible alternatives.

The conceptual alternatives analysis will focus on the ability of potential project approaches to meet the specific project goals. After the conceptual alternatives are selected, the NFP objectives and their relative weights will be used in the comparison and selection of feasible alternatives. During the feasible alternatives analysis, the nine objectives and their assigned relative weights will be used in accordance with WW75125—Guidance on Alternative Evaluation and Selection for Natural Flood Protection. The relative weights (high, medium, low, or not applicable) will aid in comparing several feasible alternatives, all of which would address the specific project objectives.

The team will consult with the Project Owner on adjusting the initially-assigned relative weights based on input from the community, public meetings, local agency input and/or technical advisory teams (Step 2, above). The alternatives comparison matrix can then emphasize established values by presenting the objectives according to their relative importance.

5.2. City, State, and Federal Regulations

The Lower Llagas Capacity Restoration Project anticipates a variety of regulatory permits and consultations may be required to complete the project, as shown in Table 5-2:

Table 5-2. Anticipated Regulatory Requirements

Agency	Permit or Requirements
U.S. Army Corp of Engineers	Clean Water Act (CWA) Section 404 individual permit may be required.
NOAA Fisheries (National Marine Fisheries Service)	Endangered Species Act Section 7 incidental take authorization and consultation may be required.
U. S. Fish and Wildlife Service	Endangered Species Act Section 7 incidental take authorization and consultation may be required.

California Department of Fish and Game	Section 1602 Streambed Alteration Agreement may be needed for activities in the channel. Additional consultation may be needed for state species of special concern that occur in the project area.
Central Coast Regional Water Quality Control Board (RWQCB)	CWA section 401 Water Quality Certification may be required and Waste Discharge Requirements may be needed.
City of Gilroy	Project will comply with applicable city ordinances.

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6. COMMUNITY OUTREACH

An important aspect of the planning process is identifying and engaging the stakeholders within the greater project area. Stakeholders can include individuals, agencies, and organizations which may affect or be affected by the Lower Llagas Capacity Restoration Project. The success of the project depends on the collaboration of these identified parties. Involving interested parties:

- Facilitates better decisions and better implementation of decisions
- Facilitates their buy-in and support for the project
- Allows interested parties greater ownership of the project
- Guards against the project becoming too inwardly focused and aids decentralized decision-making
- Helps to identify issues not addressed by the project staff

Due to the lack of many residential areas in the vicinity of Lower Llagas Creek, the project has few neighbor-based stakeholders. The majority of the stakeholders are those interested in knowing possible impacts to the site from an environmental or regulatory perspective and actions to be taken to mitigate the impacts. Thus, outreach efforts will be focused on the appropriate regulators and environmental resource groups. The Lower Llagas Capacity Restoration Project shall also include outreach to the project's neighbors and other community interests.

A preliminary list of parties who may be interested in participating in the public process for the project is included below.

- AMBAG
- California Department of Fish and Game (DFG)
- California Department of Transportation (Caltrans)
- California Regional Water Quality Control Board (RWQCB), Central Coast and San Francisco Bay Regions
- California State University Monterey Bay (CSUMB)
- City of Gilroy
- City of Morgan Hill
- Clean South Bay
- Gilroy Foods and Flavors
- League of Women Workers
- Natural Resources Conservation Service
- NOAA National Marine Fisheries Service (NMFS), Southwest Region
- San Francisco Estuary Institute (SFEI)
- Santa Clara County
- Santa Clara County Farm Bureau (SCCFB)
- Sierra Club
- South County Regional Wastewater Authority (SCRWA)
- South Valley Streams for Tomorrow
- U. S. Army Corps of Engineers

- U. S. Environmental Protection Agency (USEPA)
- U. S. Fish and Wildlife Service (USFWS)

7. POTENTIAL CHANGES TO PROJECT OBJECTIVES AND SCOPE

The initial objectives defined in the Project Plan (see Section 1.4 of this report) were analyzed based on data gathered on existing conditions, hydraulic analysis, and current environmental and regulatory conditions. Compatibility with project objectives is one of the criteria for selecting a reasonable range of project alternatives. Table 7-1 presents the current project objectives, staff's proposed project objectives based on the findings and determinations presented in this Problem Definition Report, along with the rationale for the changes.

Table 7-1. Proposed Changes to Project Objectives

Current Project Objective	Proposed Project Objective	Rationale for Change
Evaluate the current flood risk in the area surrounding the project versus the design level flood risk.	No change proposed.	
Restore, at a minimum, the level of flood risk to that provided by the 1980s project in Lower Llagas Creek.	*"Develop options to provide 100-year flood protection for Lower Llagas Creek Reach 2 beyond the Soap Lake Floodplain in accordance with FEMA criteria*. ~~Restore, at a minimum, the level of flood risk to that provided by the 1980s project in Lower Llagas Creek.~~"	Alignment with the Pajaro River Watershed Flood Prevention Authority's findings that the Soap Lake Floodplain should be preserved would remove the need to provide flood protection to the areas within the 100-year Soap Lake Floodplain, which extends from Sta. 0+00 to 70+00 (Reach 1 and approximately 1,000 feet of Reach 2A) on Lower Llagas Creek. The original project was designed using the SCS Engineering Design Standard. However, the project owner indicated that it is unnecessary to provide the level of freeboard dictated by the SCS and District standards. Thus, it was decided that the design criteria for the project would be the FEMA standard.
Identify feasible opportunities for environmental restoration and corridor preservation and incorporate into solutions.	Identify feasible opportunities for environmental restoration and corridor preservation ~~and incorporate into solutions~~.	As per the Board's Ends Policies adopted in December 2009, environmental enhancements that are less than $25,000 can be "integrated" into flood protection projects. Staff has determined that potential environmental restoration and corridor preservation opportunities for this project area would greatly exceed $25,000 in cost. Therefore, staff will identify such opportunities to the Board as independent environmental enhancements (Ends Policy E-4.1.2)

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8. NEXT STEPS

The next step of the Planning Study is to develop conceptual alternatives and analyze their ability to meet project objectives. Screening criteria will be used to determine whether a conceptual alternative would qualify as a feasible alternative. Following the feasible alternatives analysis, a staff-recommended alternative will be identified.

The Planning Study will be completed when the Planning Study Report is presented to the Board for their consideration of whether or not to proceed with the project. The Planning Study Report will summarize the process of alternatives development and evaluation to identify a staff-recommended alternative.

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9. SIGNATURES

LOWER LLAGAS CREEK
CAPACITY RESTORATION PROJECT

Project No.: 50284010

PROBLEM DEFINITION REPORT

Approved by:

Katherine Oven

Katherine Oven
Deputy Operating Officer
Watersheds Capital Projects Division

Date: 5/21/2010

C. Liang Lee

C. Liang Lee
Deputy Operating Officer
Coyote & Pajaro Watersheds Division

Date: 6/3/10

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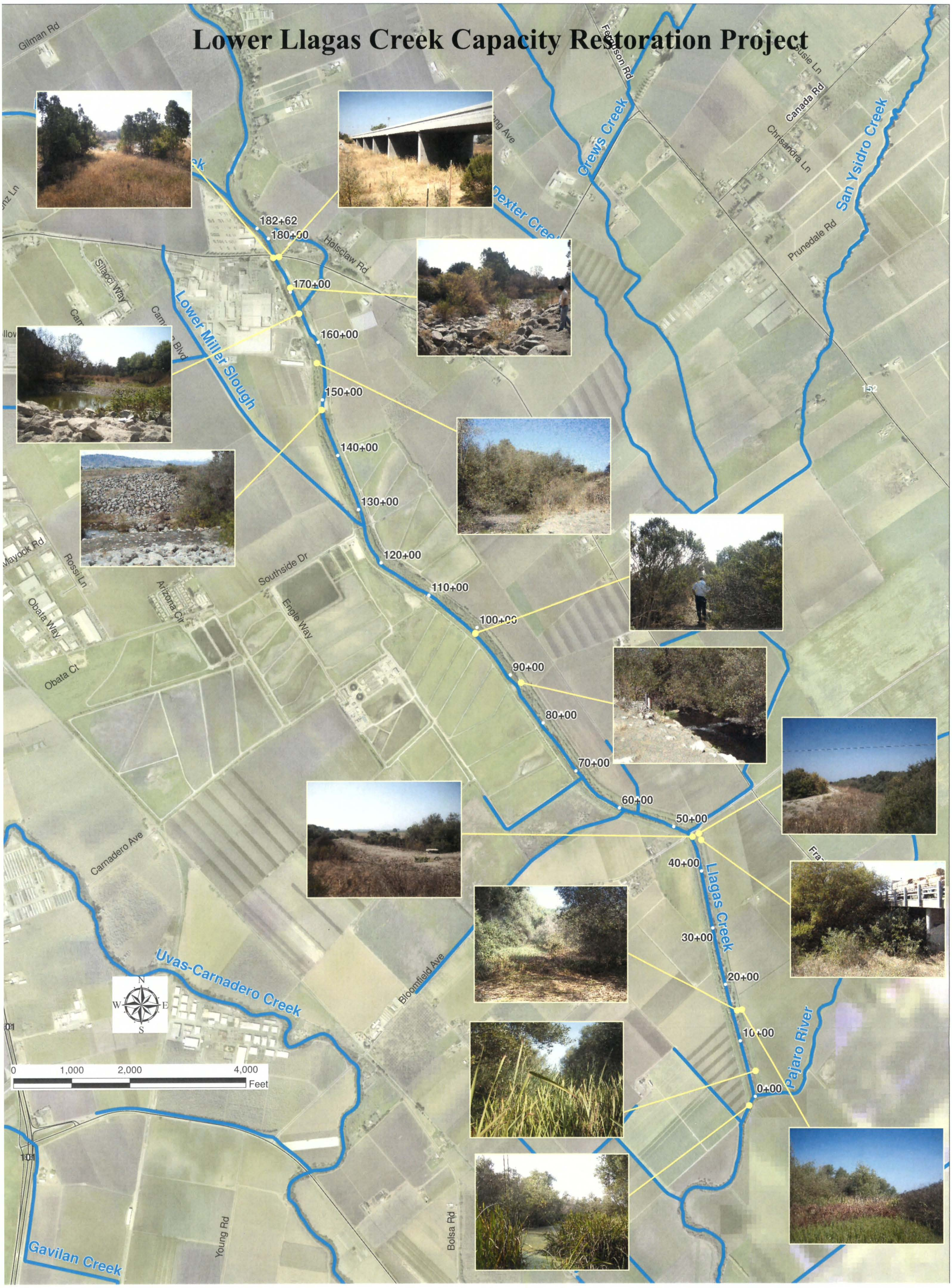
APPENDIX A

Project Location Map

Lower Llagas Creek Capacity Restoration Project



APPENDIX B

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APPENDIX C

Creek Hydrology

Santa Clara Valley
Water District

MEMORANDUM

FC 14 (01-02-07)

TO: Lower Llagas Creek Capacity Restoration Project Team

FROM: Wendy Chang, P.E.

SUBJECT: Lower Llagas Creek Hydrology

DATE: July 22, 2009

Marc Klemencic in his July 6, 2005 memo (see attachment) recommended that the flowrates from the Natural Resources Conservation Service and Corps of Engineers hydrology for the Llagas Creek PL566 project be adopted for District projects.

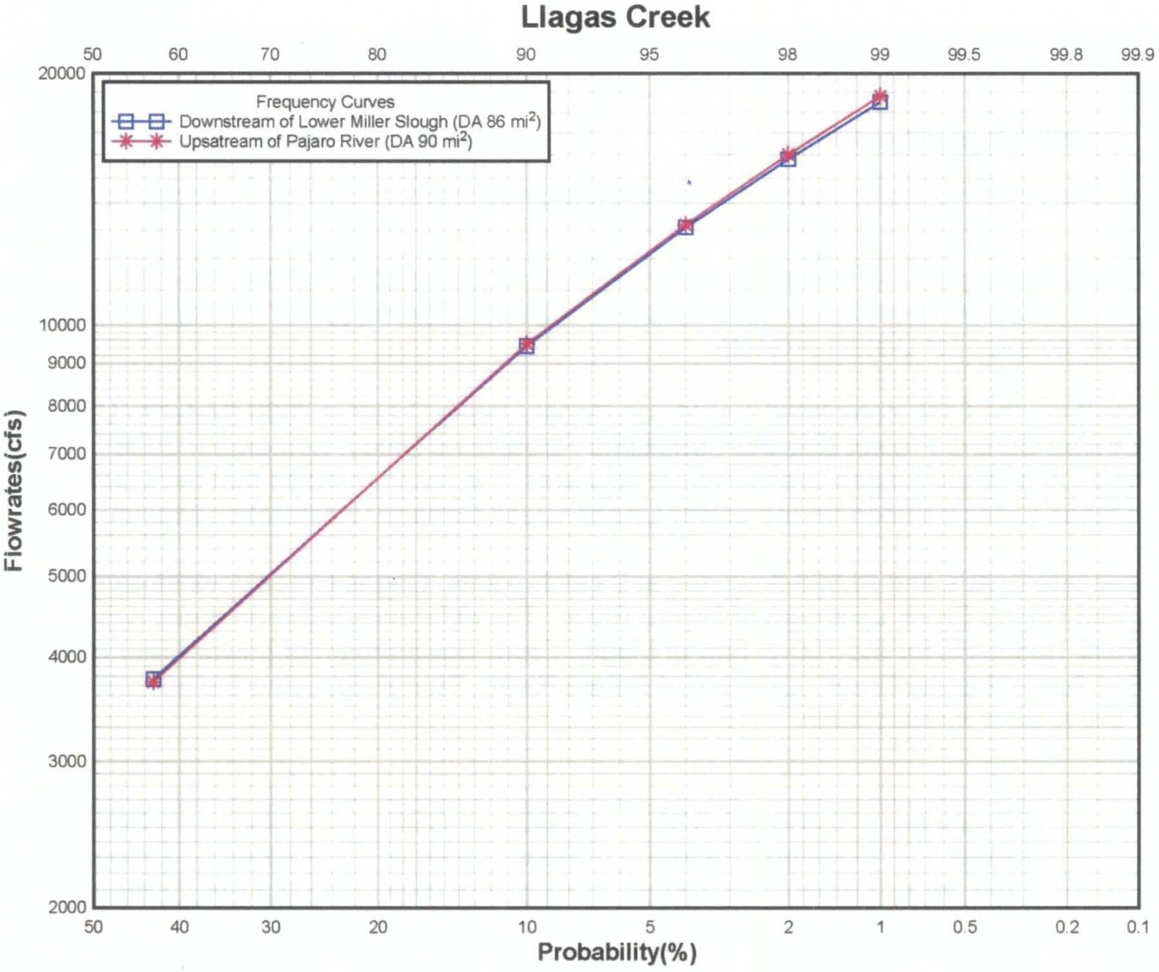
However, since then, the COE completed a study on Upper Llagas Creek in 2006 (Refer to Upper Llagas Creek Flood Control Project Existing Conditions Floodplains Study, September 2006). To be consistent with COE's Upper Llagas Creek Project flowrates, it is recommended that the 2006 COE's flowrates for Llagas Creek be used for the Lower Llagas Creek Capacity Restoration Project.

The table below lists COE's and PL566 flowrates at 2 catch points: Llagas Creek downstream of Lower Miller Slough and Llagas Creek upstream of Pajaro River. The difference between these two sets of flowrates is small, about 4% for the 100-yr flow at Llagas Creek downstream of Lower Miller Slough and 8% for the 25-yr flow at Llagas Creek upstream of Pajaro River. Therefore, using the adopted COE's hydrology for this project is reasonable.

Location	Drainage Area (sq. mi.)	PL566 Design Flow (cfs)	COE Flow 100-yr (cfs)	COE Flow 10-yr (cfs)	COE Flow 25-yr (cfs)	COE Flow 2.33-yr (cfs)	COE Flow 50-yr (cfs)
downstream of Lower Miller Slough	86	17,800*	18,500	9,450	13,100***	3,750***	15,800***
upstream of Pajaro River	90	14,300**	18,800	9,500	13,200***	3,750***	16,000***

* Return period at 100-yr
** Return period at 25-yr
*** Interpolated from 1% and 10% flows based on log Pearson Type III distribution

The figure below lists COE's flow frequency curves at 2 catch points: Llagas Creek downstream of Lower Miller Slough and Llagas Creek upstream of Pajaro River.



Attachments
cc: B.Ganjoo, L. Lee, L. Xu, J. Wang, C. Chung

Santa Clara Valley Water District

MEMORANDUM

TO: Jim Wang

FROM: Marc Klemencic

SUBJECT: Uvas & Llagas Hydrology Studies

DATE: July 6, 2005

I have completed my review of the draft Uvas Watershed and Llagas Watershed Hydrology Studies that I received from you in June 2003. I appreciate the time I have had to review these important studies and the numerous times you met with me to discuss them.

I believe that the use of the updated hydrology procedures with new regional regression equations in these studies will improve the evaluation of flood impacts from large proposed developments. It will also improve design of future flood protection projects; however, the District hydrology should be consistent with the Corps of Engineers and/or Natural Resource Conservation Service for reaches of creek where they have constructed a project in partnership with the District. We have followed this practice for Coyote Creek and Guadalupe River, so we should continue this in the Uvas and Llagas Watersheds.

On Uvas Creek, I would like to adopt the Corps of Engineers hydrology from the confluence with Pajaro River to the confluence with Little Arthur Creek, which is the first tributary upstream of the Corps of Engineers project. Even though the Corps 1% peak flow rates are a little lower than the numbers in your draft study, they are within 7% of each other.

On Llagas Creek, I would like to adopt the Natural Resource Conservation Service and Corps of Engineers hydrology for the Llagas Creek PL566 project. In many cases this will actually result in an increase in peak flows.

With these changes, I think it is appropriate to finalize your studies and publish the results as the official District hydrology.

Deputy Operating Officer
Coyote & Uvas/Llagas Watershed Division

cc: S. Katric, S. Tippets, [redacted]

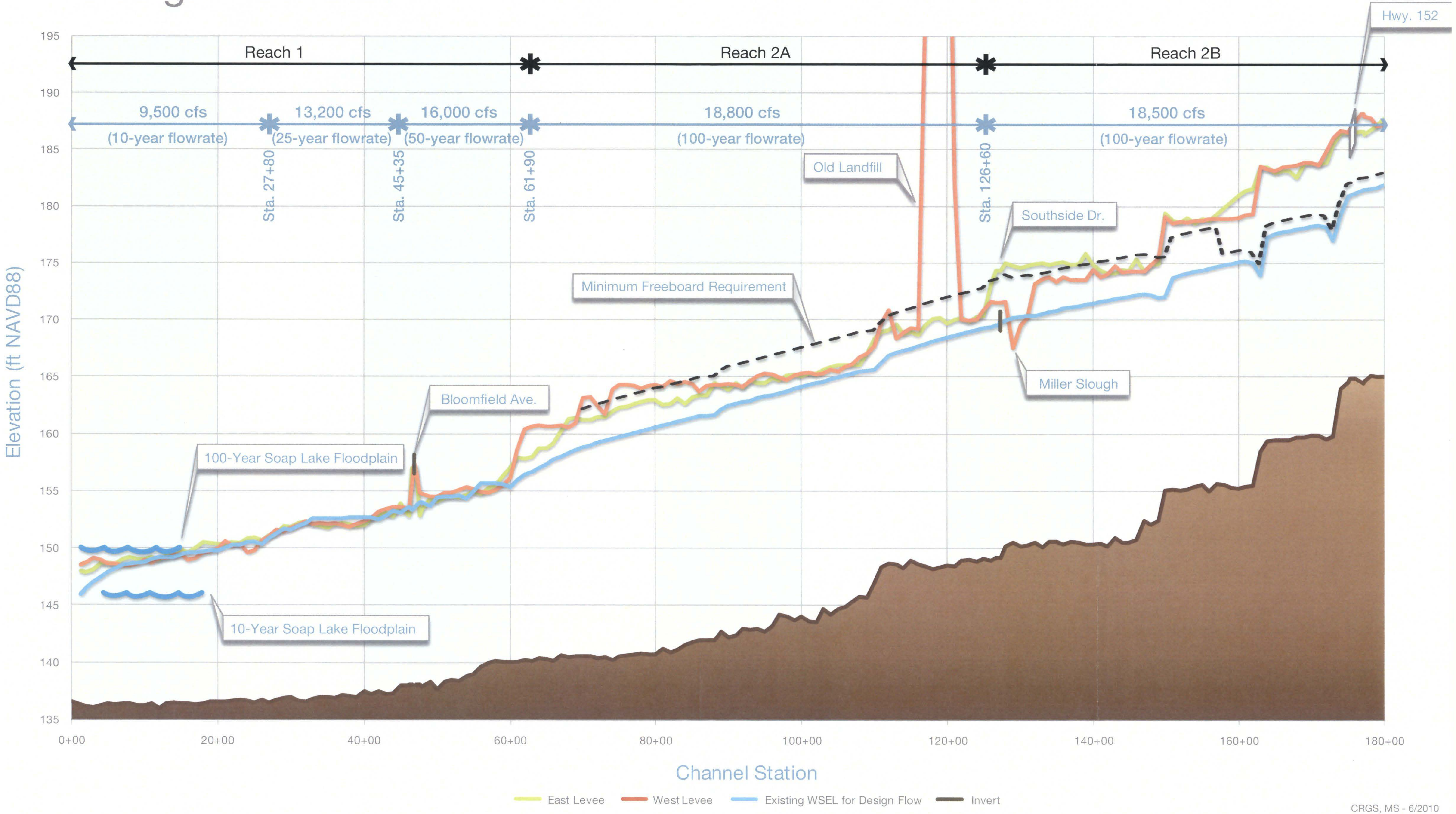
MK:km
05-35

APPENDIX D

Creek Hydraulics

Lower Llagas Creek Capacity Restoration Project

Design Flowrates



CRGS, MS - 6/2010

Lower Llagas Capacity Restoration Project
Existing Conditions
Freeboard Table

Legend

🔴	Levees overtopped
🟡	Design flow contained, but inadequate freeboard
🟢	Adequate freeboard per FEMA policy

Station (feet)	Left Levee El. (looking d/s) (ft)	Right Levee El. (looking d/s) (ft)	Q Total (cfs)	Min Ch El. (ft)	W.S. El. (ft)	Freeboard L (ft)	Freeboard R (ft)
100	148.08	148.56	9,500	136.31	145.6	🟡 2.48	🟡 2.96
200	147.84	148.71	9,500	136.17	146.43	🟡 1.41	🟡 2.28
300	148.12	149.1	9,500	136.08	146.98	🟡 1.14	🟡 2.12
400	148.67	148.9	9,500	136.25	147.42	🟡 1.25	🟡 1.48
500	148.67	148.58	9,500	136.37	147.82	🟡 0.85	🟡 0.76
600	148.62	148.59	9,500	136.33	148.22	🟡 0.40	🟡 0.37
700	149.02	148.42	9,500	136.42	148.55	🟡 0.47	🔴 (0.13)
800	149.18	148.43	9,500	136.43	148.63	🟡 0.55	🔴 (0.20)
900	149	148.58	9,500	136.24	148.72	🟡 0.28	🔴 (0.14)
1000	148.99	148.92	9,500	136.19	148.74	🟡 0.25	🟡 0.18
1100	149.16	148.7	9,500	136.41	149.04	🟡 0.12	🔴 (0.34)
1200	148.92	149.08	9,500	135.95	149.14	🔴 (0.22)	🔴 (0.06)
1300	149.36	149.1	9,500	136.43	149.15	🟡 0.21	🔴 (0.05)
1400	149.3	149.35	9,500	136.48	149.18	🟡 0.12	🟡 0.17
1500	149.8	149.4	9,500	136.41	149.46	🟡 0.34	🔴 (0.06)
1600	149.56	148.92	9,500	136.4	149.56	🟡 0.00	🔴 (0.64)
1700	150.01	149.11	9,500	136.34	149.57	🟡 0.44	🔴 (0.46)
1800	150.48	149.58	9,500	136.39	149.64	🟡 0.84	🔴 (0.06)
1900	150.45	149.67	9,500	136.56	149.72	🟡 0.73	🔴 (0.05)
2000	150.3	149.9	9,500	136.58	149.75	🟡 0.55	🟡 0.15
2100	150.33	150.55	9,500	136.52	150.01	🟡 0.32	🟡 0.54
2200	150.54	150.16	9,500	136.63	150.27	🟡 0.27	🔴 (0.11)
2300	150.42	150.33	9,500	136.74	150.27	🟡 0.15	🟡 0.06
2400	150.82	149.59	9,500	136.61	150.51	🟡 0.31	🔴 (0.92)
2500	150.91	149.77	9,500	136.49	150.54	🟡 0.37	🔴 (0.77)
2600	150.68	150.69	9,500	136.74	150.5	🟡 0.18	🟡 0.19
2700	151.06	151.03	9,500	136.48	150.73	🟡 0.33	🟡 0.30
2800	151.29	151.55	13,200	136.76	150.89	🟡 0.40	🟡 0.66
2900	151.88	151.43	13,200	136.87	151.29	🟡 0.59	🟡 0.14
3000	151.86	151.75	13,200	136.98	151.65	🟡 0.21	🟡 0.10
3100	152.16	151.96	13,200	136.66	152.02	🟡 0.14	🔴 (0.06)
3200	152.33	152.31	13,200	136.59	151.95	🟡 0.38	🟡 0.36
3300	152.05	152.05	13,200	136.84	152.34	🔴 (0.29)	🔴 (0.29)
3400	151.93	152.17	13,200	137	152.35	🔴 (0.42)	🔴 (0.18)
3500	151.73	152.07	13,200	137	152.37	🔴 (0.64)	🔴 (0.30)
3600	152.05	152.16	13,200	136.93	152.39	🔴 (0.34)	🔴 (0.23)
3700	152.14	151.96	13,200	137.18	152.4	🔴 (0.26)	🔴 (0.44)
3800	152.1	151.85	13,200	137.02	152.42	🔴 (0.32)	🔴 (0.57)
3900	151.93	152.05	13,200	136.96	152.44	🔴 (0.51)	🔴 (0.39)
4000	151.98	152.31	13,200	137.5	152.45	🔴 (0.47)	🔴 (0.14)
4100	152.47	152.61	13,200	137.25	152.27	🟡 0.20	🟡 0.34
4200	152.88	153.2	13,200	137.51	152.62	🟡 0.26	🟡 0.58
4300	153.11	153.37	13,200	137.25	152.97	🟡 0.14	🟡 0.40

Station (feet)	Left Levee El. (looking d/s) (ft)	Right Levee El. (looking d/s) (ft)	Q Total (cfs)	Min Ch El. (ft)	W.S. El. (ft)	Freeboard	
						L (ft)	R (ft)
4400	152.76	153.61	13,200	137.34	153.33	🔴 (0.57)	🟡 0.28
4500	153.91	153.6	13,200	137.96	153.22	🟡 0.69	🟡 0.38
4591.631	152.99	153.53	16,000	137.96	153.59	🔴 (0.60)	🔴 (0.06)
4611.64	152.8	153.44	16,000	138.03	153.6	🔴 (0.80)	🔴 (0.16)
4663	157	157	16,000	138.03	153.28	🟡 3.72	🟡 3.72
4684.5	0	0	Bridge	0	0	0.00	0.00
4705	157	157	16,000	138.08	153.72	🟡 3.28	🟡 3.28
4761.43	152.84	154.84	16,000	138.08	154.25	🔴 (1.41)	🟡 0.59
4784.396	153.33	154.71	16,000	137.86	154.27	🔴 (0.94)	🟡 0.44
4900	154.29	154.52	16,000	138.33	153.99	🟡 0.30	🟡 0.53
5000	154.08	154.5	16,000	137.63	154.76	🔴 (0.68)	🔴 (0.26)
5100	154.38	154.8	16,000	138.33	154.71	🔴 (0.33)	🟡 0.09
5200	154.5	154.82	16,000	138.47	154.85	🔴 (0.35)	🔴 (0.03)
5300	154.42	155.08	16,000	138.42	154.8	🔴 (0.38)	🟡 0.28
5400	154.67	155.33	16,000	138.84	154.84	🔴 (0.17)	🟡 0.49
5500	154.92	155.12	16,000	138.97	154.56	🟡 0.36	🟡 0.56
5600	154.71	154.89	16,000	139.67	155.34	🔴 (0.63)	🔴 (0.45)
5700	155.25	154.85	16,000	140	155.36	🔴 (0.11)	🔴 (0.51)
5800	155.52	155.1	16,000	140.12	155.31	🟡 0.21	🔴 (0.21)
5900	156.35	155.48	16,000	140.05	155.02	🟡 1.33	🟡 0.46
6000	157.09	156.15	16,000	140.05	155.62	🟡 1.47	🟡 0.53
6100	157.88	158.54	16,000	140.08	156.2	🟡 1.68	🟡 2.34
6200	157.81	160.39	16,000	140.22	156.63	🟡 1.18	🟢 3.76
6300	158.01	160.67	18,800	140.17	156.86	🟡 1.15	🟢 3.81
6400	158.71	160.73	18,800	140.34	157.2	🟡 1.51	🟢 3.53
6500	158.76	160.6	18,800	140.33	157.52	🟡 1.24	🟡 3.08
6600	159.16	160.64	18,800	140.09	157.92	🟡 1.24	🟡 2.72
6700	160.23	160.75	18,800	140.59	158.22	🟡 2.01	🟡 2.53
6800	161.32	160.58	18,800	140.48	158.53	🟡 2.79	🟡 2.05
6900	161.37	160.87	18,800	140.58	158.76	🟡 2.61	🟡 2.11
7000	161.2	163.15	18,800	140.52	158.99	🟡 2.21	🟢 4.16
7100	161.21	163.18	18,800	140.53	159.19	🟡 2.02	🟢 3.99
7200	161.45	162.42	18,800	140.36	159.37	🟡 2.08	🟡 3.05
7300	161.5	161.74	18,800	140.5	159.57	🟡 1.93	🟡 2.17
7400	161.92	163.86	18,800	140.22	159.77	🟡 2.15	🟢 4.09
7500	162.31	164.31	18,800	140.54	159.93	🟡 2.38	🟢 4.38
7600	162.4	164.27	18,800	140.64	160.1	🟡 2.30	🟢 4.17
7700	162.63	164.17	18,800	140.69	160.28	🟡 2.35	🟢 3.89
7800	162.83	163.98	18,800	140.82	160.44	🟡 2.39	🟢 3.54
7900	162.94	164.2	18,800	140.68	160.6	🟡 2.34	🟢 3.60
8000	162.94	164.29	18,800	140.75	160.75	🟡 2.19	🟢 3.54
8100	162.56	164.1	18,800	141.2	160.9	🟡 1.66	🟡 3.20
8200	162.64	164.64	18,800	140.86	161.06	🟡 1.58	🟢 3.58
8300	163.08	164.35	18,800	141.16	161.22	🟡 1.86	🟡 3.13
8400	162.66	164.56	18,800	141.51	161.37	🟡 1.29	🟡 3.19
8500	163.21	164.39	18,800	141.81	161.52	🟡 1.69	🟡 2.87
8600	163.35	163.74	18,800	141.98	161.71	🟡 1.64	🟡 2.03
8700	163.37	164.2	18,800	141.98	161.76	🟡 1.61	🟡 2.44
8800	164.44	164.25	18,800	141.97	161.8	🟡 2.64	🟡 2.45
8900	164.2	164.32	18,800	142.69	162.32	🟡 1.88	🟡 2.00
9000	163.9	164.37	18,800	142.22	162.64	🟡 1.26	🟡 1.73

Station (feet)	Left Levee El. (looking d/s) (ft)	Right Levee El. (looking d/s) (ft)	Q Total (cfs)	Min Ch El. (ft)	W.S. El. (ft)	Freeboard	
						L (ft)	R (ft)
9100	164.46	164.27	18,800	142.39	162.78	🟡 1.68	🟡 1.49
9200	164	164.09	18,800	142.92	162.93	🟡 1.07	🟡 1.16
9300	164.72	164.59	18,800	142.91	163.08	🟡 1.64	🟡 1.51
9400	164.49	165	18,800	142.97	163.25	🟡 1.24	🟡 1.75
9500	164.42	165.24	18,800	142.7	163.43	🟡 0.99	🟡 1.81
9600	164.9	165.21	18,800	143.17	163.58	🟡 1.32	🟡 1.63
9700	164.72	164.96	18,800	144.17	163.74	🟡 0.98	🟡 1.22
9800	165.08	164.71	18,800	144.06	163.91	🟡 1.17	🟡 0.80
9900	165.17	165.08	18,800	143.69	164.1	🟡 1.07	🟡 0.98
10000	165	165.28	18,800	144.02	164.25	🟡 0.75	🟡 1.03
10100	165.28	165.4	18,800	143.65	164.42	🟡 0.86	🟡 0.98
10200	165.3	165.17	18,800	143.51	164.59	🟡 0.71	🟡 0.58
10300	165.63	165.32	18,800	144.71	164.75	🟡 0.88	🟡 0.57
10400	165.87	165.6	18,800	144.17	164.91	🟡 0.96	🟡 0.69
10500	166.06	165.48	18,800	144.66	165.08	🟡 0.98	🟡 0.40
10600	166	165.87	18,800	144.84	165.25	🟡 0.75	🟡 0.62
10700	166.06	166.1	18,800	145.33	165.42	🟡 0.64	🟡 0.68
10800	166	166.71	18,800	145.76	165.61	🟡 0.39	🟡 1.10
10900	167.02	166.98	18,800	145.72	165.66	🟡 1.36	🟡 1.32
11000	168.32	167.68	18,800	146.99	165.74	🟡 2.58	🟡 1.94
11100	168.89	169.71	18,800	148.33	166.39	🟡 2.50	🟡 3.32
11200	169.13	170.85	18,800	148.65	167	🟡 2.13	🟢 3.85
11300	169.57	168.33	18,800	148.59	167.23	🟡 2.34	🟡 1.10
11400	168.73	168.82	18,800	148.25	167.44	🟡 1.29	🟡 1.38
11500	168.92	169.28	18,800	148.89	167.63	🟡 1.29	🟡 1.65
11600	168.68	169.18	18,800	148.56	167.82	🟡 0.86	🟡 1.36
11700	169.55	198.12	18,800	148.46	168.01	🟡 1.54	🟢 30.11
11800	170.1	212.58	18,800	148.16	168.22	🟡 1.88	🟢 44.36
11900	170.21	226.38	18,800	148.33	168.41	🟡 1.80	🟢 57.97
12000	169.68	218.13	18,800	148.5	168.59	🟡 1.09	🟢 49.54
12100	170.03	181.98	18,800	148.4	168.75	🟡 1.28	🟢 13.23
12200	170.2	170.03	18,800	148.93	168.92	🟡 1.28	🟡 1.11
12300	169.85	169.95	18,800	149	169.05	🟡 0.80	🟡 0.90
12400	170.25	170.04	18,500	148.85	169.25	🟡 1.00	🟡 0.79
12500	170.35	170.83	18,500	149.08	169.4	🟡 0.95	🟡 1.43
12600	173.17	171.55	18,500	148.94	169.54	🟡 3.63	🟡 2.01
12670	174.3	171.5	18,500	149.17	169.66	🟢 4.64	🟡 1.84
12691	174.3	171.5	18,500	149.17	169.7	🟢 4.60	🟡 1.80
12704.5	0	0	Bridge	0	0	0.00	0.00
12718	174.3	171.5	18,500	149.17	169.92	🟢 4.38	🟡 1.58
12730	174.3	171.5	18,500	149.17	169.95	🟢 4.35	🟡 1.55
12800	175	171.57	18,500	150.21	170.07	🟢 4.93	🟡 1.50
12900	174.75	167.55	18,500	150.5	170.3	🟢 4.45	🔴 (2.75)
13000	174.58	169.48	18,500	150.16	170.4	🟢 4.18	🔴 (0.92)
13100	174.72	170.21	18,500	150.25	170.51	🟢 4.21	🔴 (0.30)
13200	174.87	173.18	18,500	150.5	170.49	🟢 4.38	🟡 2.69
13300	175	173.56	18,500	150.06	170.66	🟢 4.34	🟡 2.90
13400	174.83	173.71	18,500	150.57	170.78	🟢 4.05	🟡 2.93
13500	174.99	173.31	18,500	150.55	170.92	🟢 4.07	🟡 2.39
13600	175.08	173.73	18,500	150.33	171.09	🟢 3.99	🟡 2.64
13700	174.79	173.52	18,500	150.62	171.23	🟢 3.56	🟡 2.29

Station (feet)	Left Levee El. (looking d/s) (ft)	Right Levee El. (looking d/s) (ft)	Q Total (cfs)	Min Ch El. (ft)	W.S. El. (ft)	Freeboard	
						L (ft)	R (ft)
13800	174.93	173.53	18,500	150.48	171.33	🟢 3.60	🟡 2.20
13900	175.78	173.53	18,500	150.33	171.42	🟢 4.36	🟡 2.11
14000	174.85	174.43	18,500	150.33	171.52	🟡 3.33	🟡 2.91
14100	174.34	173.72	18,500	150.46	171.66	🟡 2.68	🟡 2.06
14200	174.08	174	18,500	150.14	171.77	🟡 2.31	🟡 2.23
14300	174.08	174.74	18,500	150.94	171.92	🟡 2.16	🟡 2.82
14400	174.37	174.19	18,500	150.5	172.03	🟡 2.34	🟡 2.16
14500	174.33	174.25	18,500	150.54	172.13	🟡 2.20	🟡 2.12
14600	175.3	174.23	18,500	150.78	172.26	🟡 3.04	🟡 1.97
14700	174.25	174.27	18,500	152.38	172.32	🟡 1.93	🟡 1.95
14800	174.8	174.82	18,500	152.1	172.3	🟡 2.50	🟡 2.52
14900	174.88	175.37	18,500	152.42	172.04	🟡 2.84	🟡 3.33
15000	179.39	179.09	18,500	155.09	172.09	🟢 7.30	🟢 7.00
15100	178.72	178.5	18,500	155.14	173.74	🟢 4.98	🟢 4.76
15200	178.58	178.62	18,500	155.09	174	🟢 4.58	🟢 4.62
15300	178.96	178.55	18,500	155.16	174.14	🟢 4.82	🟢 4.41
15400	178.51	178.69	18,500	155.43	174.29	🟢 4.22	🟢 4.40
15500	178.91	178.76	18,500	155.58	174.42	🟢 4.49	🟢 4.34
15600	178.75	178.87	18,500	155	174.56	🟢 4.19	🟢 4.31
15700	179.29	178.93	18,500	155.63	174.7	🟢 4.59	🟢 4.23
15800	179.16	178.62	18,500	155.59	174.84	🟢 4.32	🟢 3.78
15900	179.09	178.63	18,500	155.31	174.97	🟢 4.12	🟢 3.66
16000	179.51	178.6	18,500	155.23	175.13	🟢 4.38	🟢 3.47
16100	179.84	178.51	18,500	155.37	175.21	🟢 4.63	🟢 3.30
16200	179.81	178.71	18,500	155.51	175.01	🟢 4.80	🟢 3.70
16300	181.21	182.67	18,500	158.46	174.01	🟢 7.20	🟢 8.66
16400	181.66	180.38	18,500	159.35	177.23	🟢 4.43	🟢 3.15
16500	181.4	181.06	18,500	159.46	177.59	🟢 3.81	🟢 3.47
16600	181.61	181.02	18,500	159.48	177.72	🟢 3.89	🟢 3.30
16700	182.03	181.26	18,500	159.46	177.83	🟢 4.20	🟢 3.43
16800	182.66	182.23	18,500	159.69	177.98	🟢 4.68	🟢 4.25
16900	182.38	181.74	18,500	159.72	178.08	🟢 4.30	🟢 3.66
17000	183.46	181.62	18,500	159.92	178.21	🟢 5.25	🟢 3.41
17100	183.25	181.6	18,500	159.88	178.33	🟢 4.92	🟢 3.27
17200	184.01	183.8	18,500	159.58	178.17	🟢 5.84	🟢 5.63
17300	184.78	184.76	18,500	159.78	176.95	🟢 7.83	🟢 7.81
17400	184.26	185.66	18,500	163.95	179.21	🟢 5.05	🟢 6.45
17508.72	185.92	183.28	18,500	164.55	180.92	🟢 5.00	🟢 2.36
17530.57	185.74	183.7	18,500	164.83	180.97	🟢 4.77	🟢 2.73
17592	187	186	18,500	164.83	181.06	🟢 5.94	🟢 4.94
17639.5	0	0	Bridge	0	0	0.00	0.00
17687	190	188.19	18,500	164.43	181.4	🟢 8.60	🟢 6.79
17709.85	184.7	183.93	18,500	164.43	181.43	🟢 3.27	🟢 2.50
17731.34	184.49	184.24	18,500	164.58	181.45	🟢 3.04	🟢 2.79
17820	186.17	187.31	18,500	165.09	181.51	🟢 4.66	🟢 5.80
17900	187.1	183.17	18,500	165.06	181.67	🟢 5.43	🟢 1.50
18000	189.51	184.16	18,500	165.01	181.86	🟢 7.65	🟢 2.30

APPENDIX E

Geotechnical Investigation

Santa Clara Valley Water District

MEMORANDUM

TO: Liang Xu

FROM: Mohammad Khan

SUBJECT: Lower Llagas Creek Levee Evaluation

DATE: April 20, 2009

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1. Introduction:

This memorandum summarizes the Lower Llagas Creek levee design and construction information gathered from the available project plans and construction specifications, and present the results of our evaluation of existing levee conditions based on site inspections and project file review. On January 29, 2009, accompanied by Mr. Liang Xu, we visited the levee sites along Reach 1, Reach 2A. and Reach 2B of Lowe Llagas Creek. The following sections present a summary of original levee design data; evaluation of existing levee conditions; and conclusions and recommendations for additional levee investigations and levee improvements work that would be necessary to satisfy the Federal Emergency Management Agency (FEMA) requirements for future levee certification.

2. Summary of Levee Design Data & Construction Specifications:

The project file records indicate that the original levees were designed by the United States Soil Conservation Service (USSCS) and constructed between the period of 1973 and 1994 in different reaches. The levees were typically designed with 2:1 (horizontal to vertical) slopes having a semi-compacted or compacted central core and a 2 foot thick outer shell with un-compacted loose fill. The loose fill on the outer shell was apparently placed for growing plants and vegetation. However, the compaction specifications for central core of the levees typically called for 90 percent relative compaction based on ASTM D -698 Standard, which results in lower compaction of levee fill than current ASTM Standard D-1557. Although, specifications called to perform field density tests during construction to verify compliance with 90% compaction, we could not find any records of field tests in the project file to confirm that the levee fills were compacted to 90% as specified.

The specifications indicate that the levees were constructed with native silty or clayey fill materials obtained from channel excavations. The USSCS boring data show the levee foundation soils are typically silty clays or clays with some lenses of sands and gravel. Their geotechnical reports do not show any shear strength data and slope stability or levee settlement analysis. **A list of project file reports that were reviewed are attached to this memorandum for reference.**

3. **Existing Levee Conditions:**

Reach 1 (East Levee): Our observations indicate that the existing levee generally looks good, except some minor cracks and sloughing of inboard slope near the downstream end. The top soils on both inboard and outboard slopes appear to be loose fill covered with plants and vegetation. The central part of the levee crest appears to be a relatively firm, compacted surface, and there is no sign of uneven settlement along the levee alignment.

Reach 1 (West Levee): Our observations indicate that the existing conditions of west levee are similar to that of east levee along Reach 1. The only exceptions are that both the levee slopes and top of the levee contain soft or loose un-compacted fill along the length of about 2000 feet from the downstream end, and both the outboard and inboard levee slopes have developed some shallow cracks and sliding planes in this area. The levee conditions beyond about 2000 feet from the downstream end appear to be firm, compacted along the levee crest, and loose fill over the slopes for plant and vegetation growth. .

Reach 2A (West Levee): The west levee along the Reach 2A generally looks good. During our field observation, we did not notice any assign of cracks, bulging, or sloughing on the levee slopes, and overall the levee looked firm, uniform, and compacted on the top. The fill on the slopes appeared to be relatively firm and uniform.

Reach 2A (East Levee): The condition of east levee along this reach looks similar to that of west levee. Generally the east levee looks firm, uniform, and compacted without showing any sign of cracks, sloughing, or settlement.

Reach 2B (West Levee): There is no much levee along the west bank of Reach 2B. There only a low-height levee (height less than about 3 feet) along a small portion of the west bank. This low levee appeared to be in a good condition.

Reach 2B (East Levee): The east levee along the Reach 2B generally looks good, except there is an irrigation ditch running along the central part of the levee starting from the downstream end. This irrigation ditch appears to be as deep as the height of the levee, and the ditch s a trapezoidal section with steep side slope. The seep side slope is exposed and has no vegetation cover or other slope protection.

During our site visit, we took some photographs of existing levees showing some minor cracks and sloughing of levee slopes. The photographs taken during our site visit are attached to this memorandum for reference.

4. **Conclusions:**

Based on our review of levee design and recent site visit, we conclude that generally the existing levee along the reaches are generally in stable condition.

There is no immediate threat to the structural integrity and safety of these levees.
Although these levees were constructed with less than current standard of compaction, and provided with 2-foot thick loose fill over the slopes, it appears that the levee fill and its foundation soils have consolidated over the years, and become stronger with time.

As such, the shape and structure of the levee appears to be intact except some minor cracks, bulging, and sloughing of levee slopes in creation area. These minor cracks, and sloughing of levee slopes will require some periodic maintenance work to maintain the levees in safe conditions to provide the current level of flood protection.

However, the design and construction records from the project file indicate that these levees would not satisfy the current FEMA requirements for levee certification. Additional geotechnical investigations, analyses, and levee evaluation would be necessary for FEMA certification.

5. **Recommendations:**

We recommend the following steps be taken in order to preserve the current level of flood protection:

- Review the latest survey data along the levee alignments to determine levee top elevation, and compare with the original levee design elevation to estimate the amount of settlement that may have occurred over the years.
- Perform some maintenance work to repair the existing cracks, and sloughing of levee slopes in order to prevent further deterioration of levee structures.
- If the current project objective is to provide 100-year flood protection, and obtain FEMA certification and flood map revision, then prepare a budget and work plan for additional geotechnical investigations and evaluation of existing levees.

We trust this memorandum provides you enough information about the condition of exiting levees along the Lower Llagas Creek reaches, and recommendations to help the project team develop an appropriate project plan for flood protection. If you have any questions, please contact the under signed at extension 2734.

Sincerely,

Mohammad A Khan
Mohammad A. Khan, P.E.
Senior Engineer, Structural Engineering Unit
Capital Program Services Division

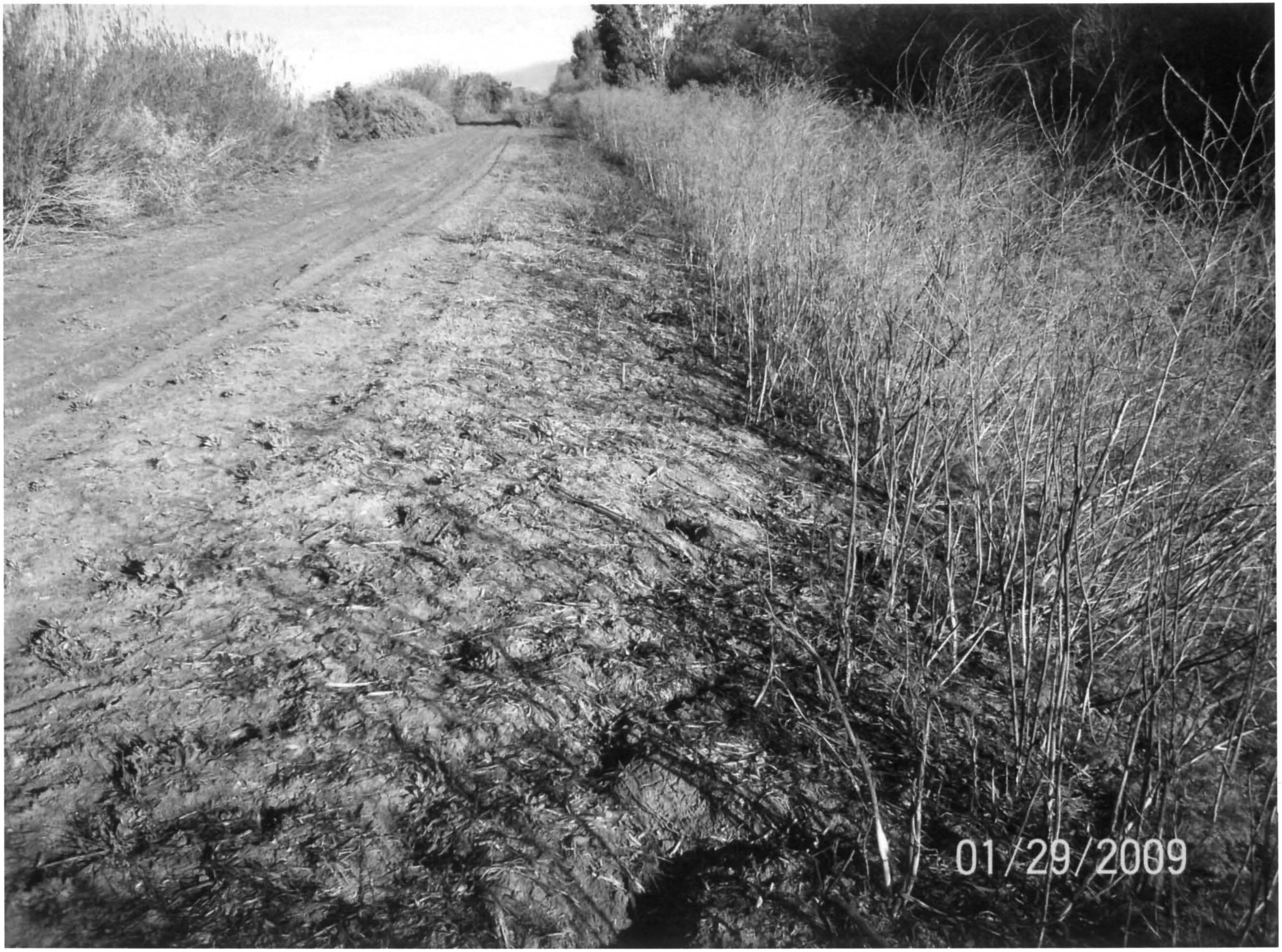
Attachment:

Cc: Bal Ganjoo; Chrisy Chung ; M. Khan

References:

1. Geologic Report for Llagas Creek, Reach 2, July, 1982, by Jerald M. Curry, Soil Conservation Service, U.S Department of Agriculture (USDA).
2. Llagas Creek (Reach 2) Design Report (Phase 1), February, 1982, Santa Clara valley water District.
3. Llagas Creek Reach-2A Final Design Report, November, 1982, by Santa Clara Valley Water District and USDA, Soil Conservation Service.
4. Lower Llagas Creek Reach 2B Final Design Report, October, 1983, by USDA, Soil Conservation Service.
5. Plans & Specifications of Llagas Creek Watershed Reach 2A-1, 1084, by USDA, Soil Conservation Service.
6. Lower Llagas Creek Watershed Channel Improvement, Project No. 50028, 1973, by USDA, Soil Conservation Service.

Reach 1 West Levee



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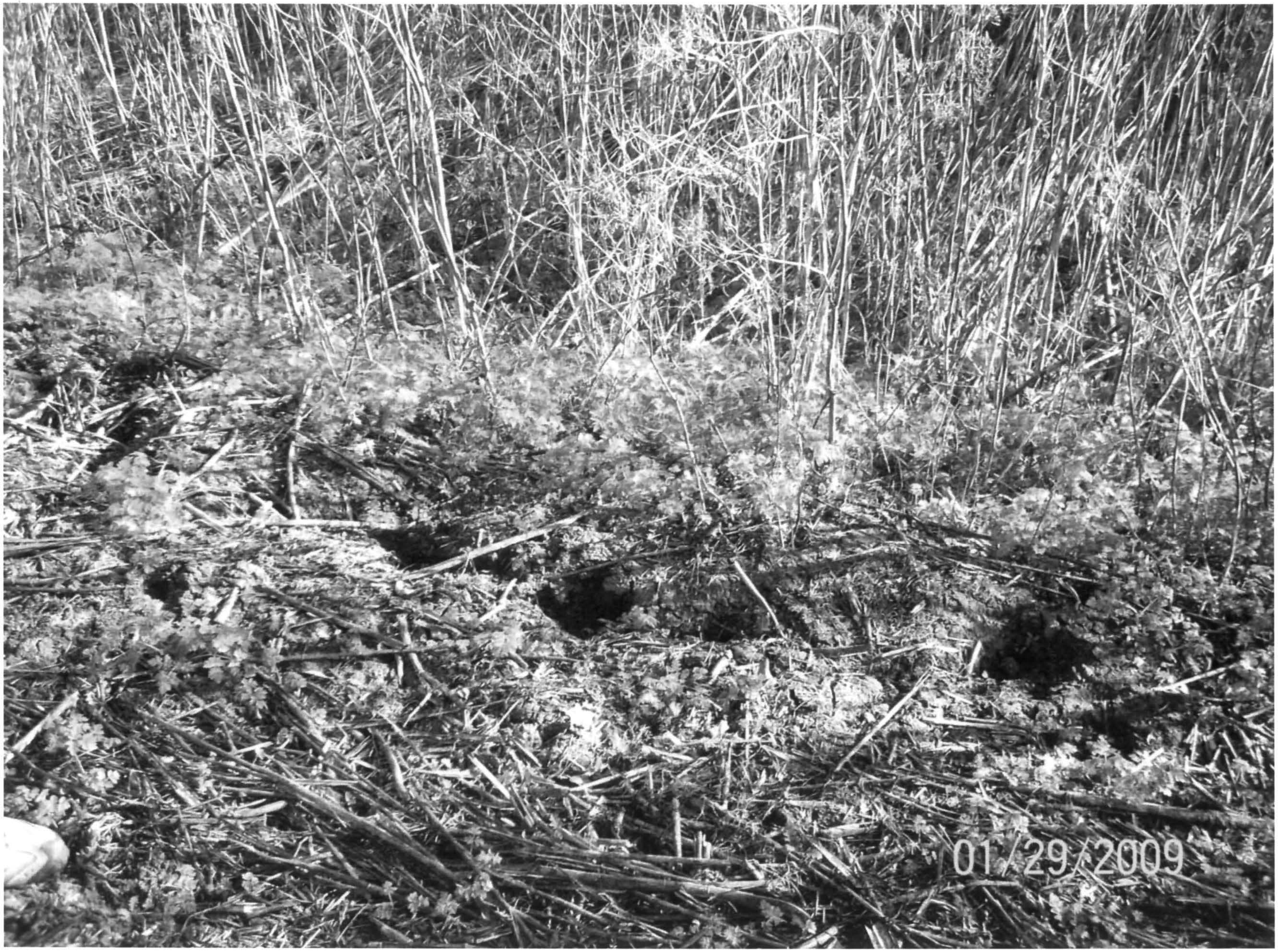
Reach 1 West



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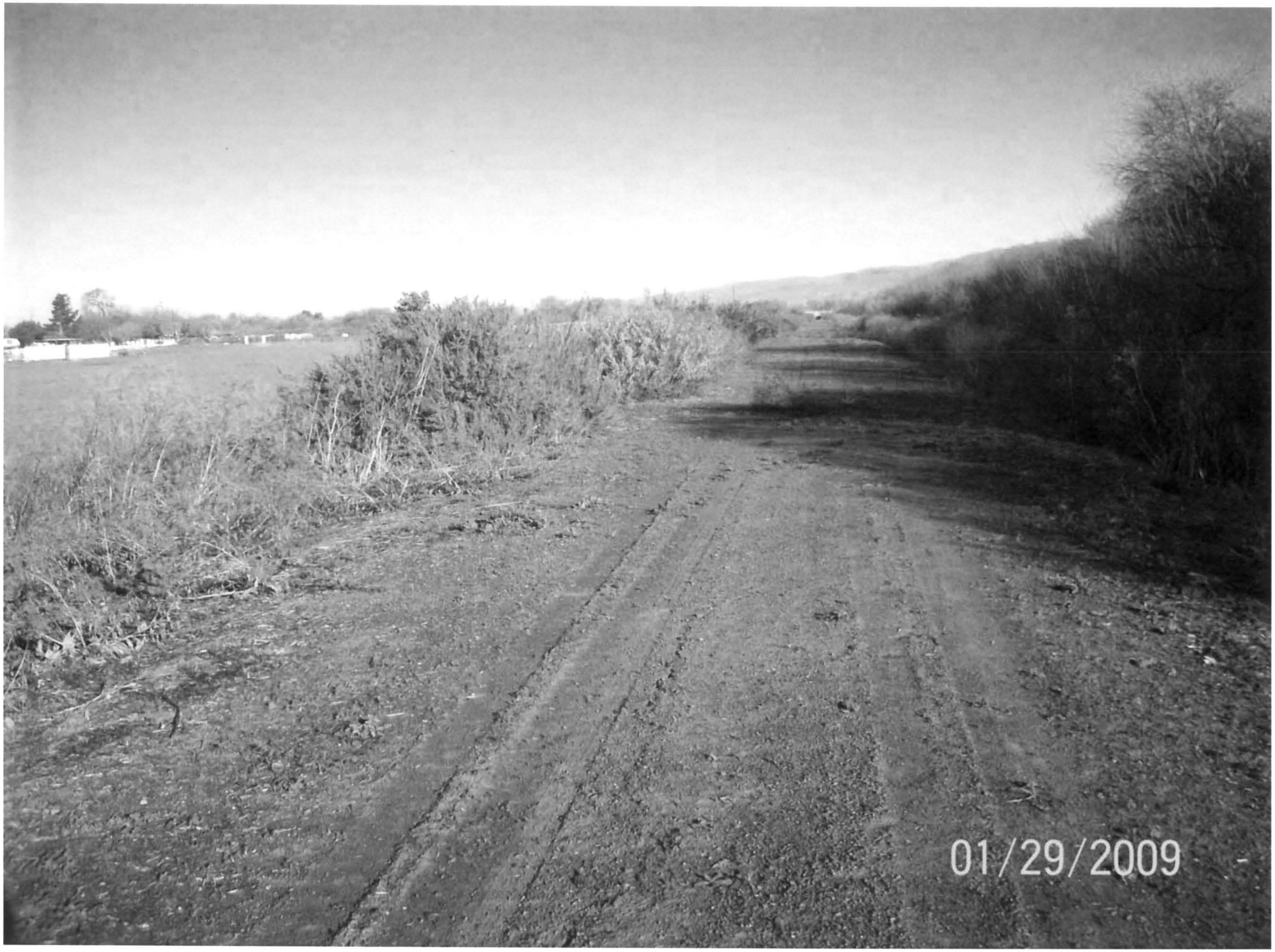

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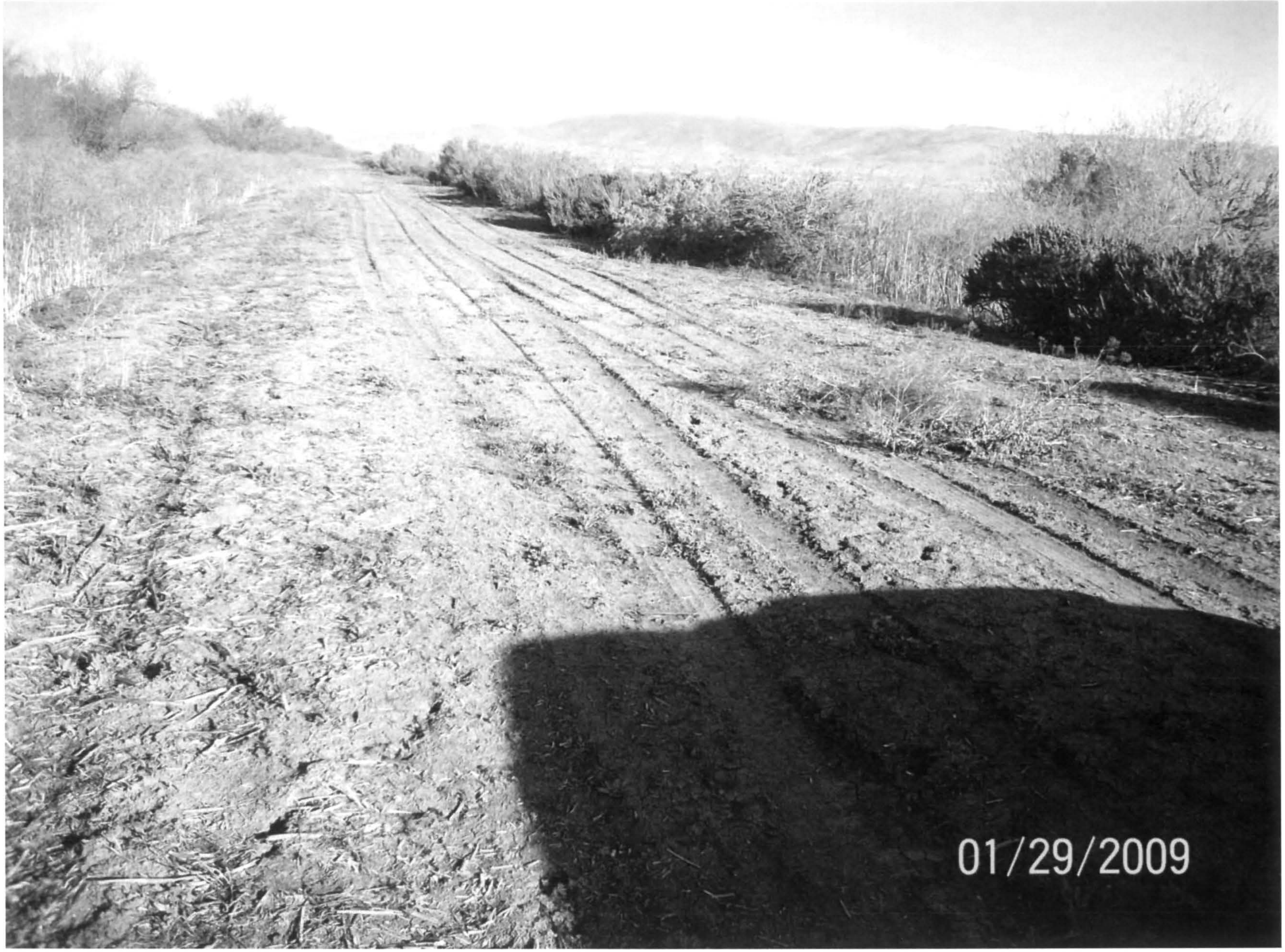

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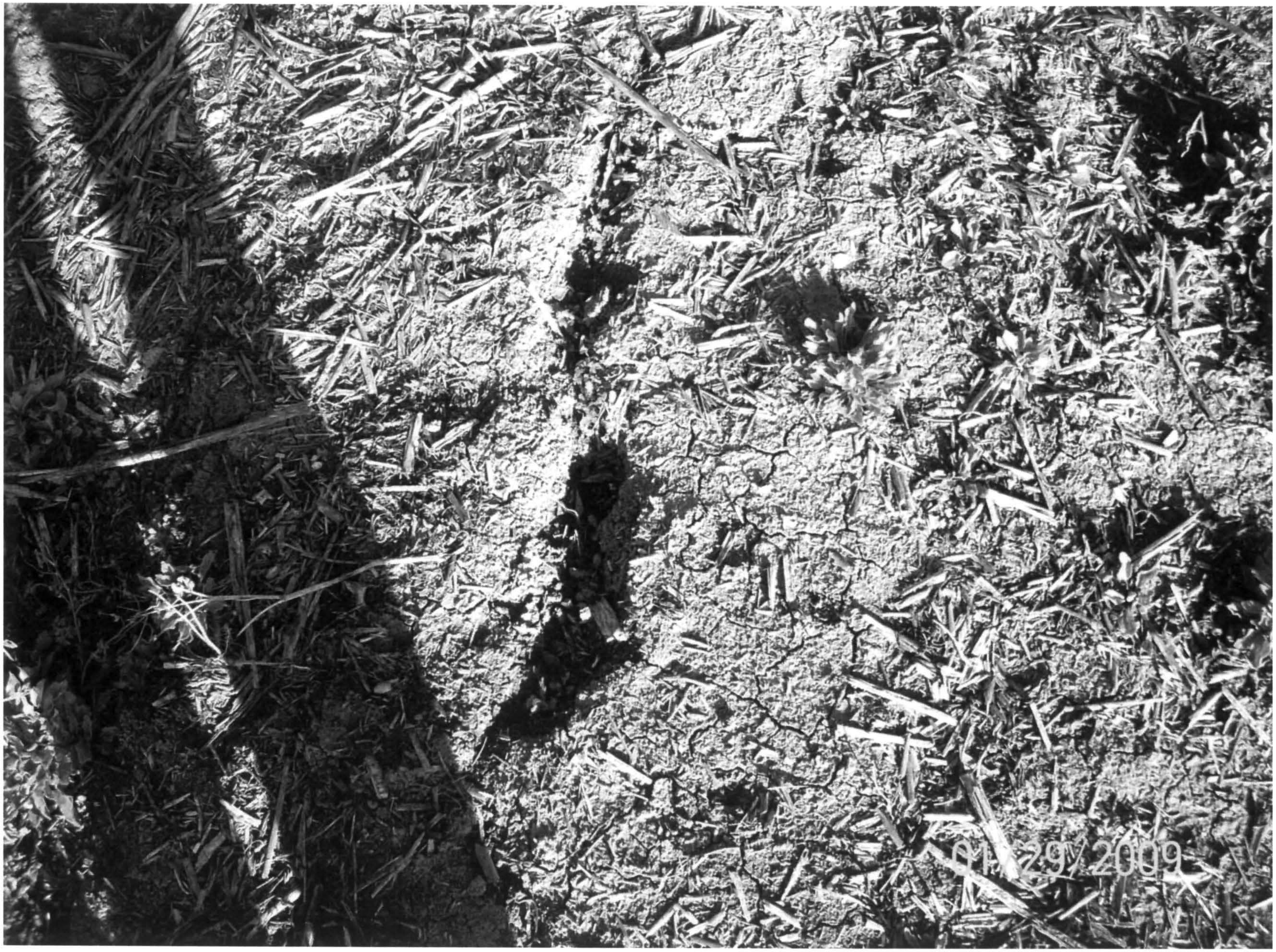

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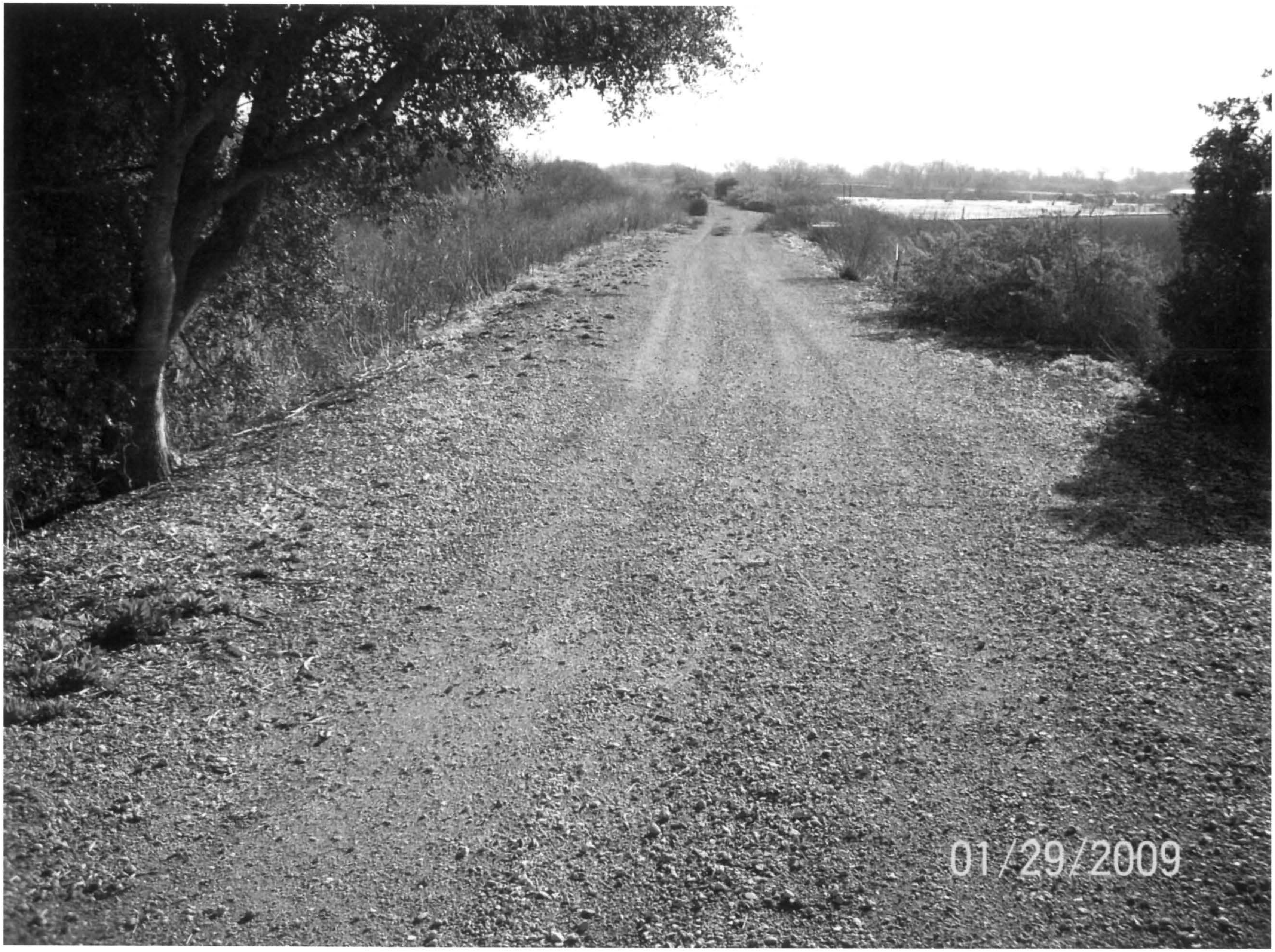

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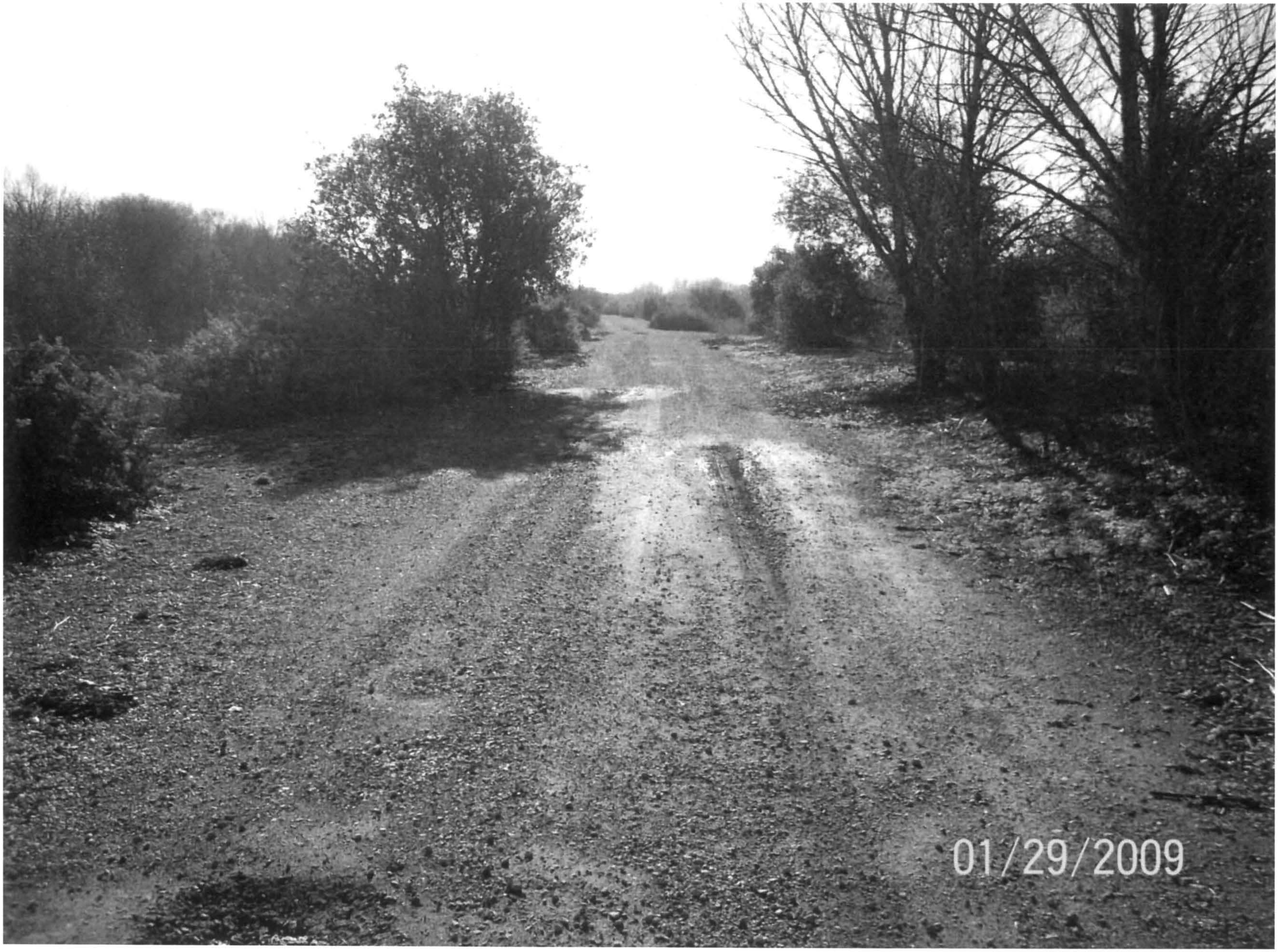

01/29/2009

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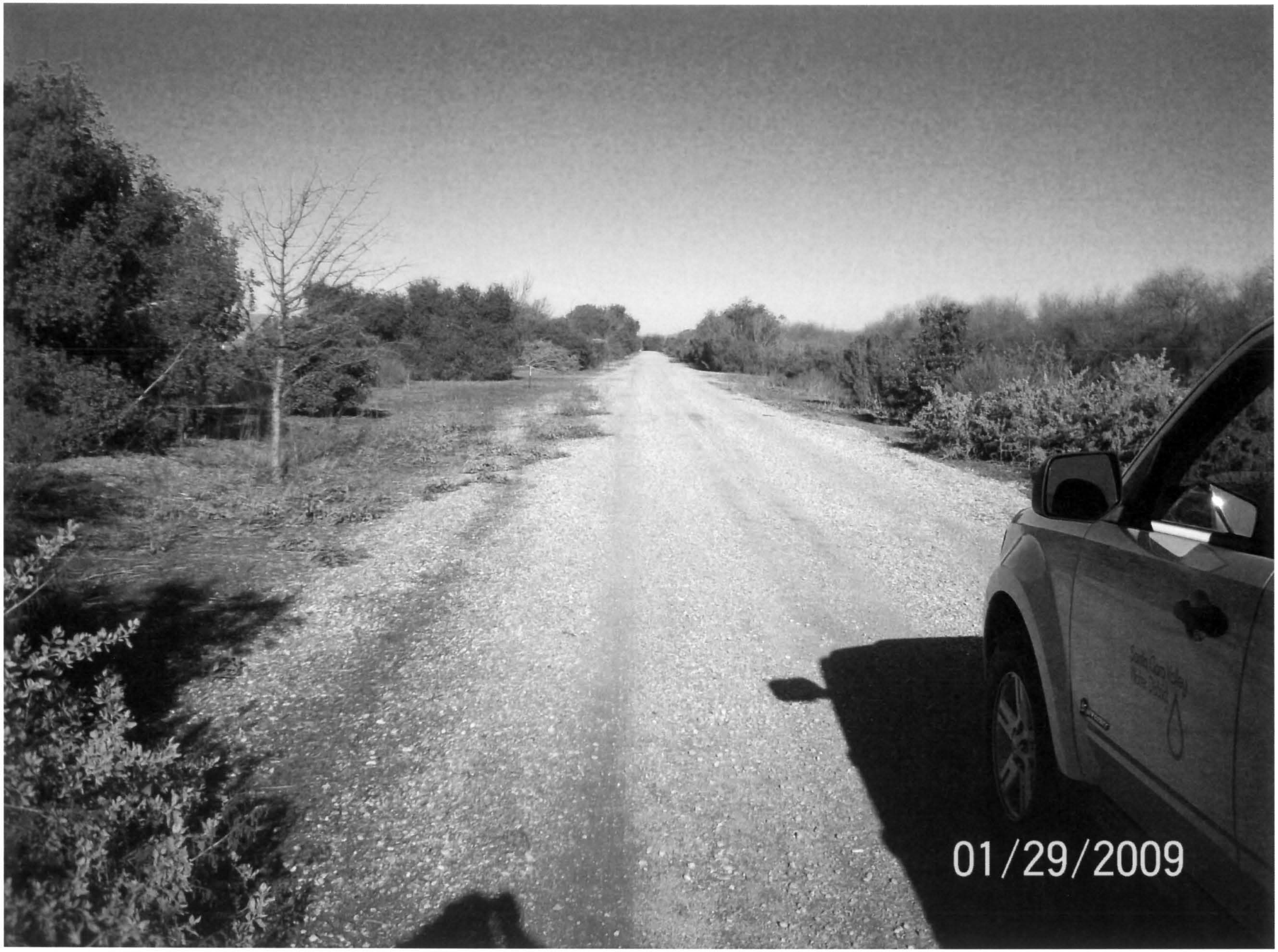

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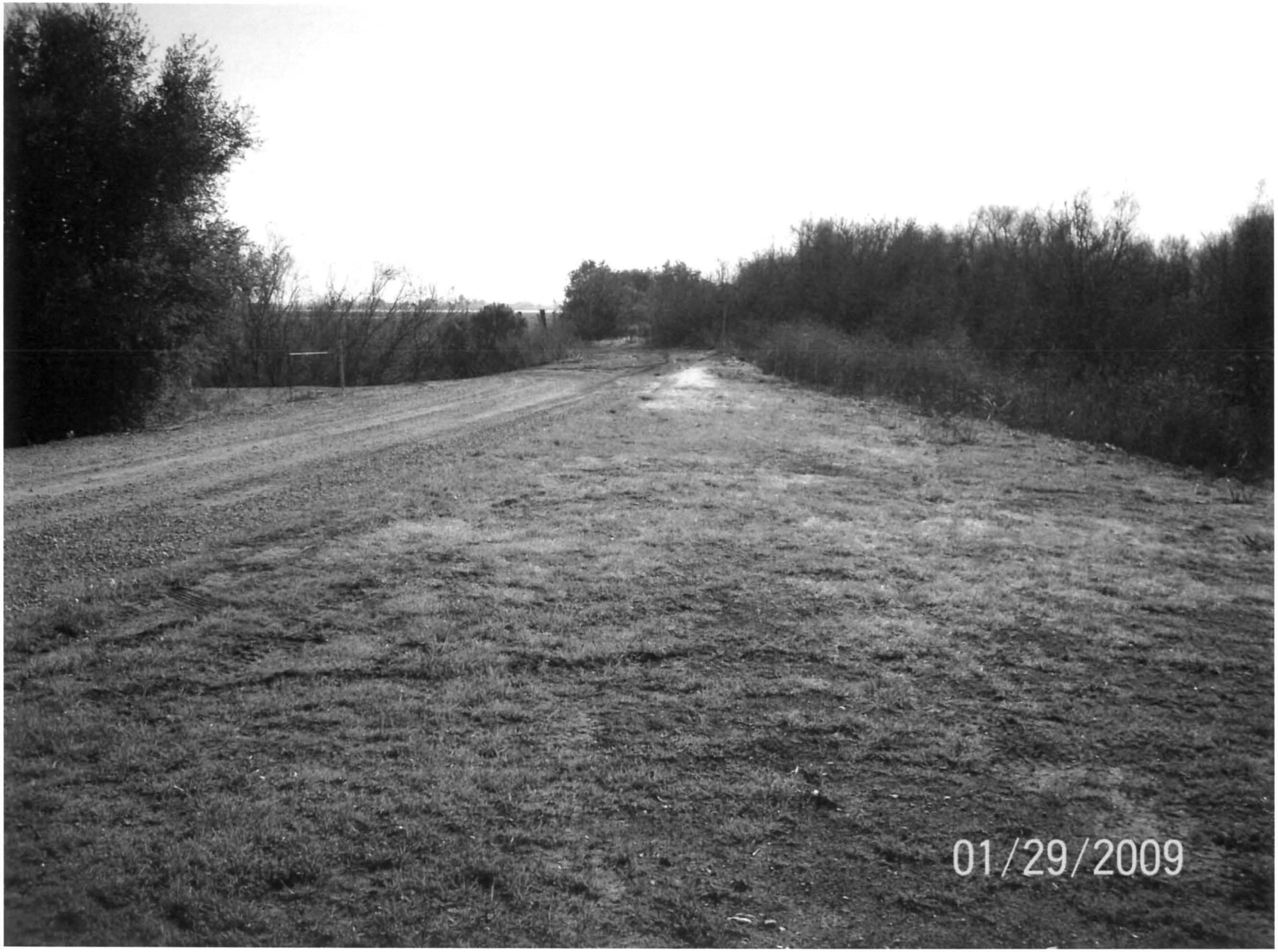

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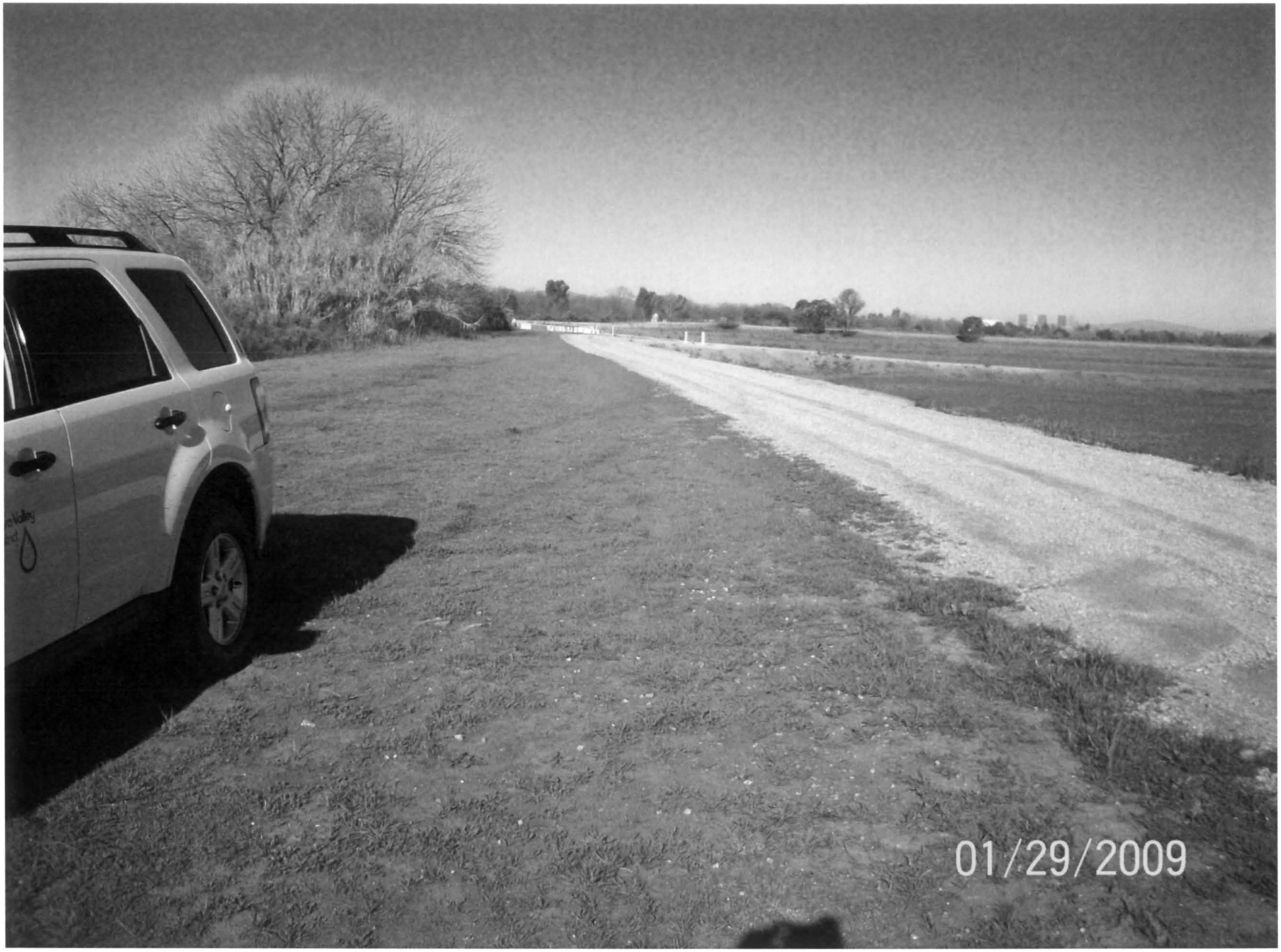

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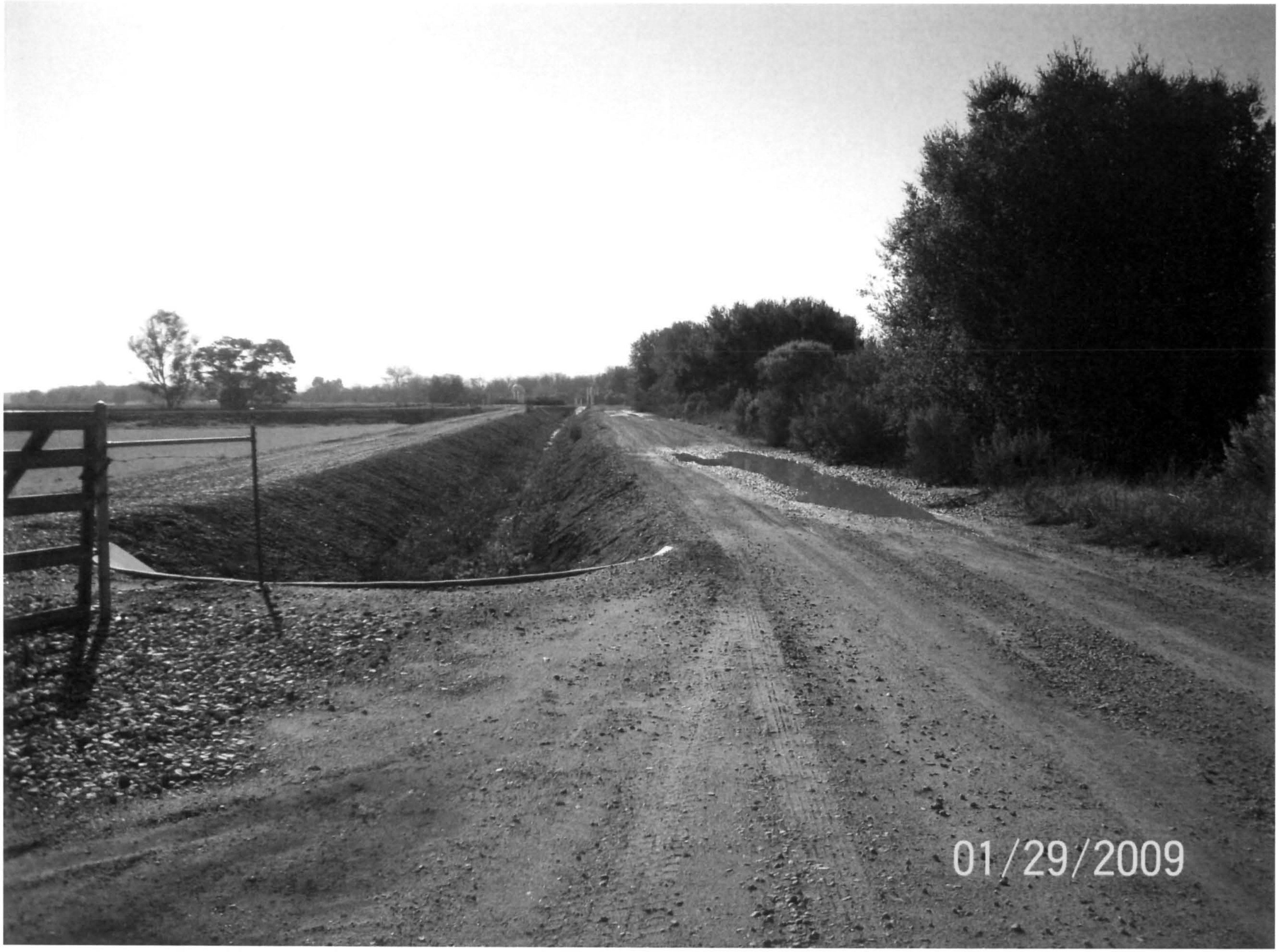

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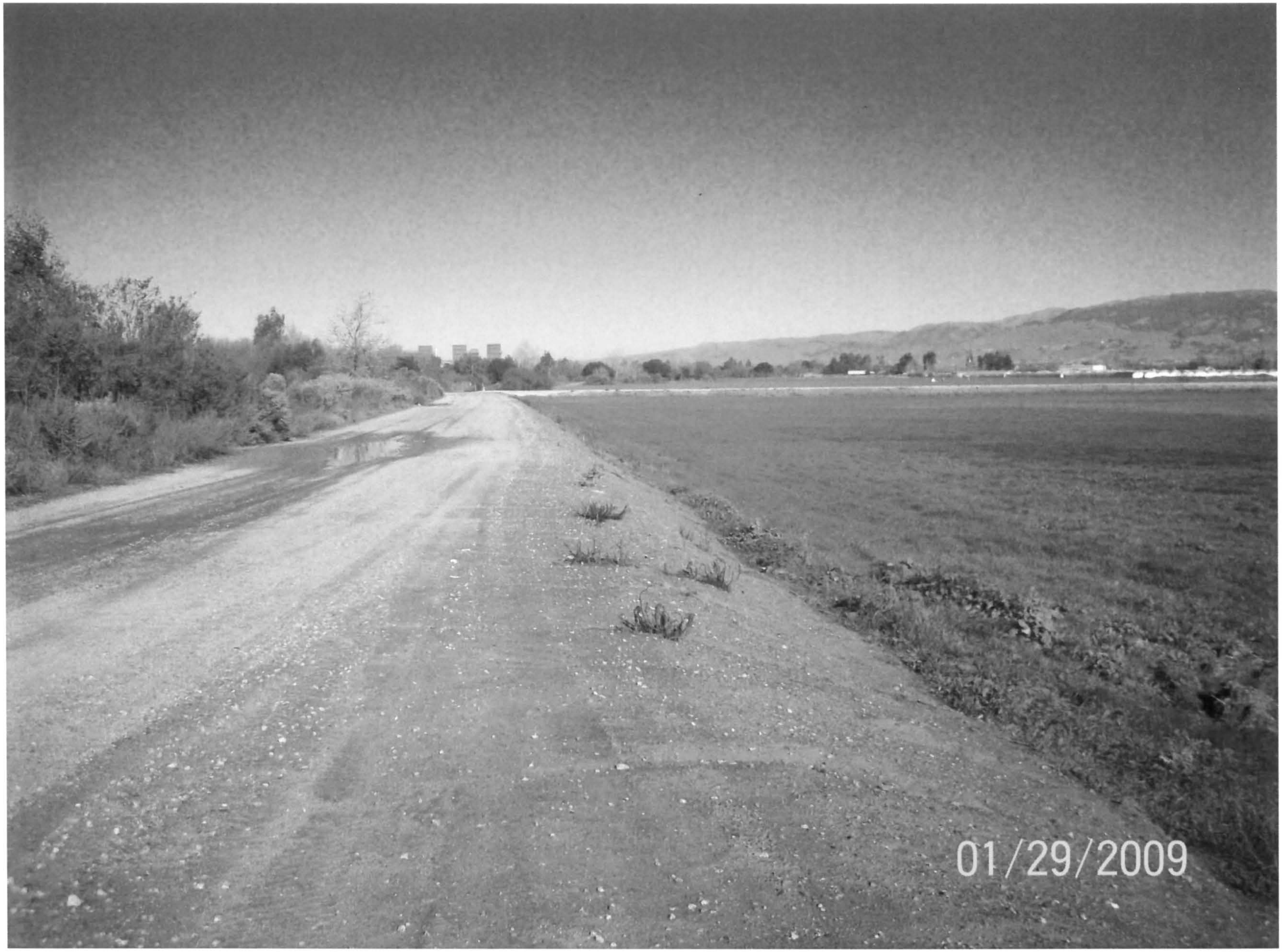

APPENDIX F

Existing Conditions Maps

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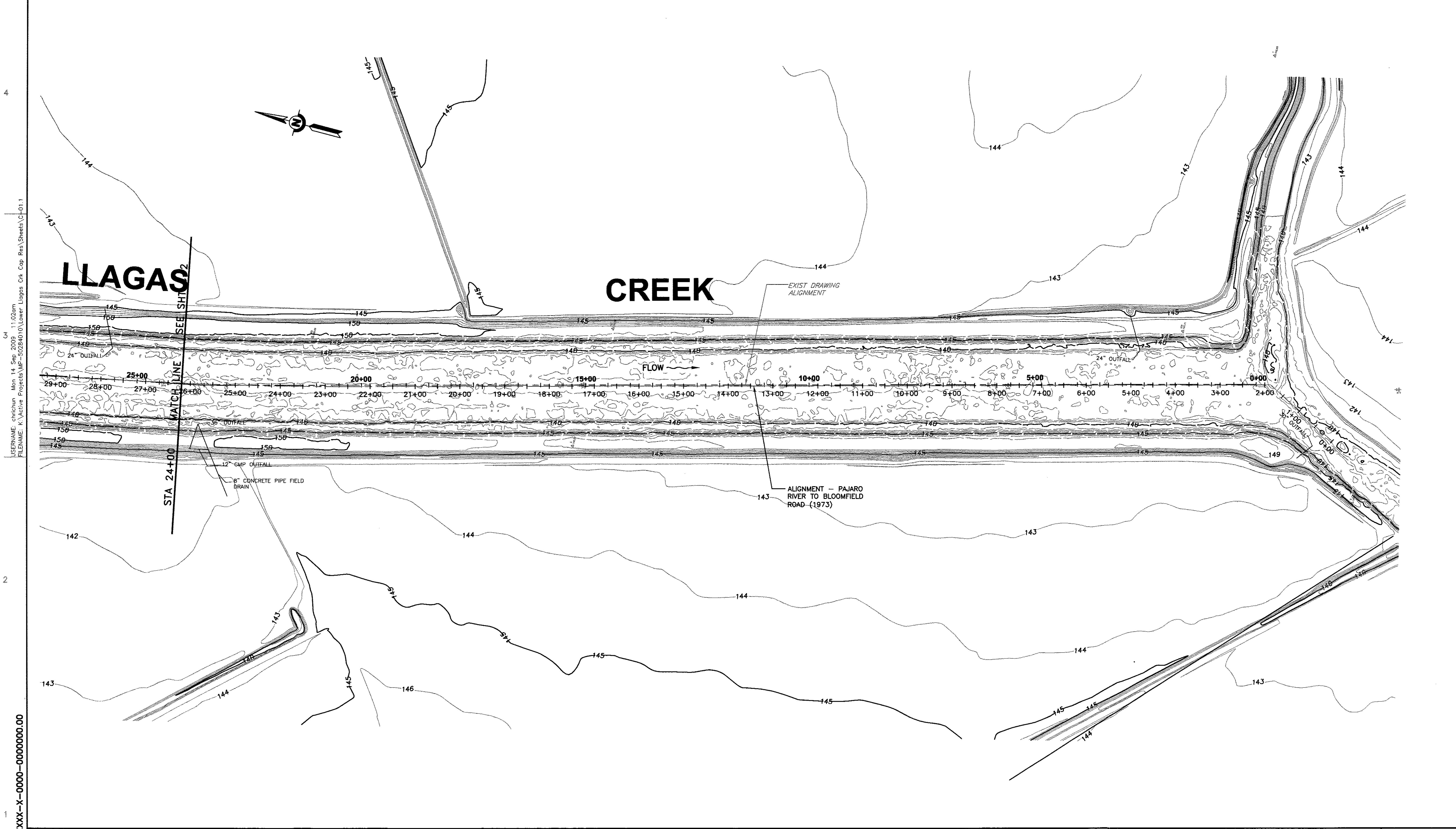

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

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DRAWN	J. CORDOVA
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Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

LOWER LLAGAS CAPACITY RESTORATION PROJECT

PLAN
STA 0+00 TO STA 24+00

SCALE
1" = 100'

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
50284010

SHEET CODE:
C-1

PAGE NUMBER:
1 OF 7

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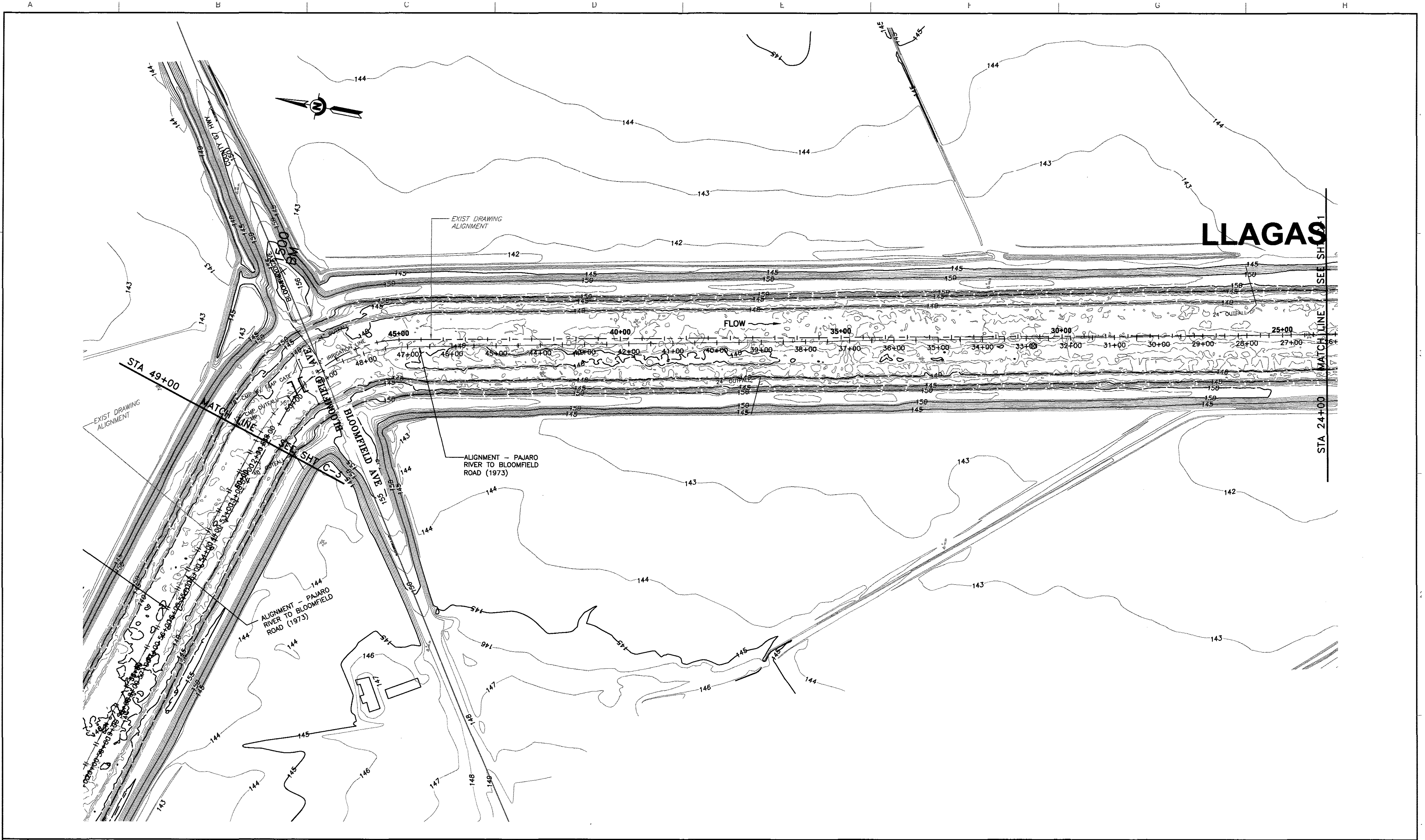

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PROJECT NUMBER
50284010
SHEET CODE:
C-2
PAGE NUMBER:
2 OF 7

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

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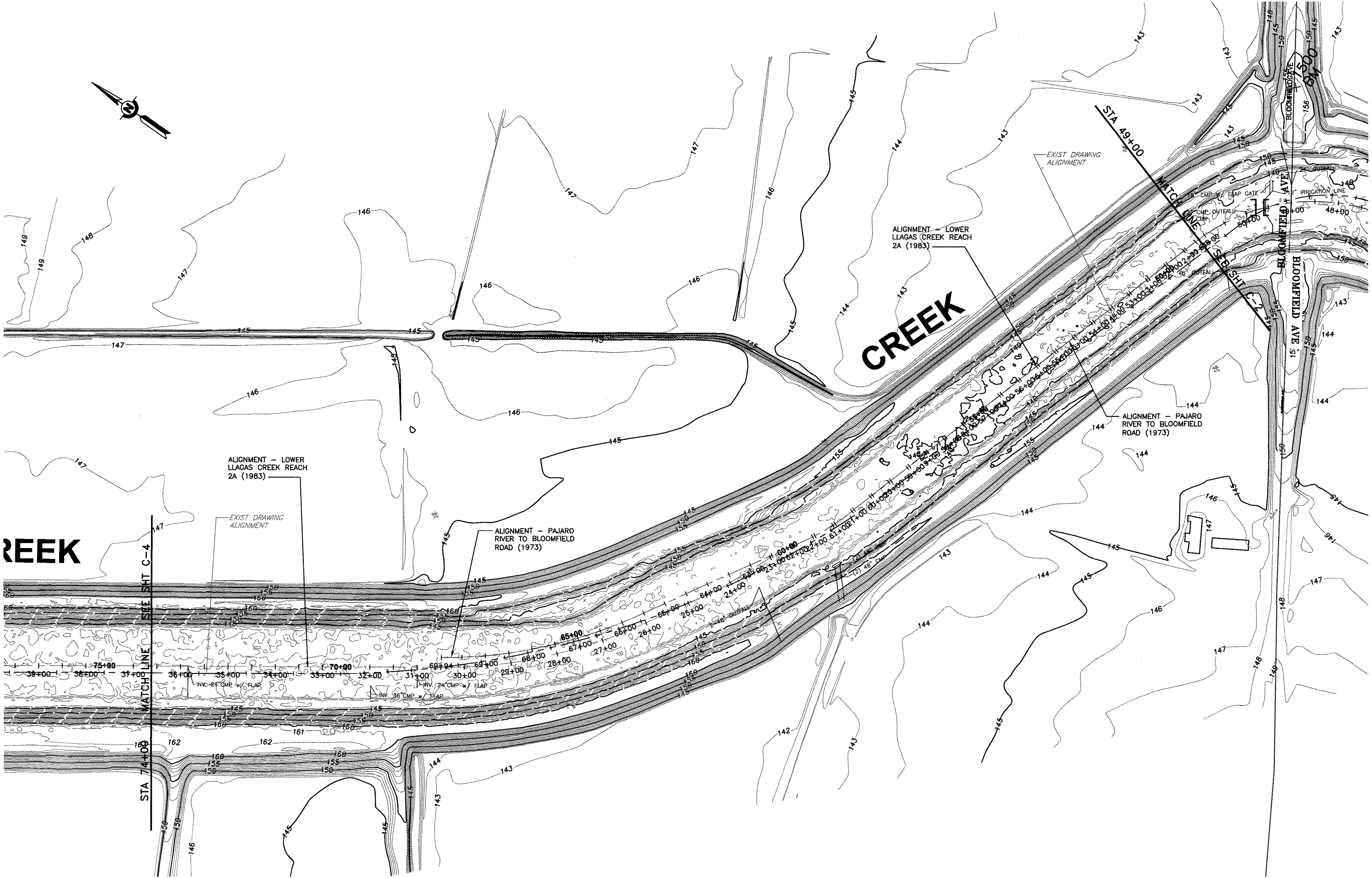

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PROJECT NUMBER
50284010
SHEET CODE:
C-3
PAGE NUMBER:
3 OF 7

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

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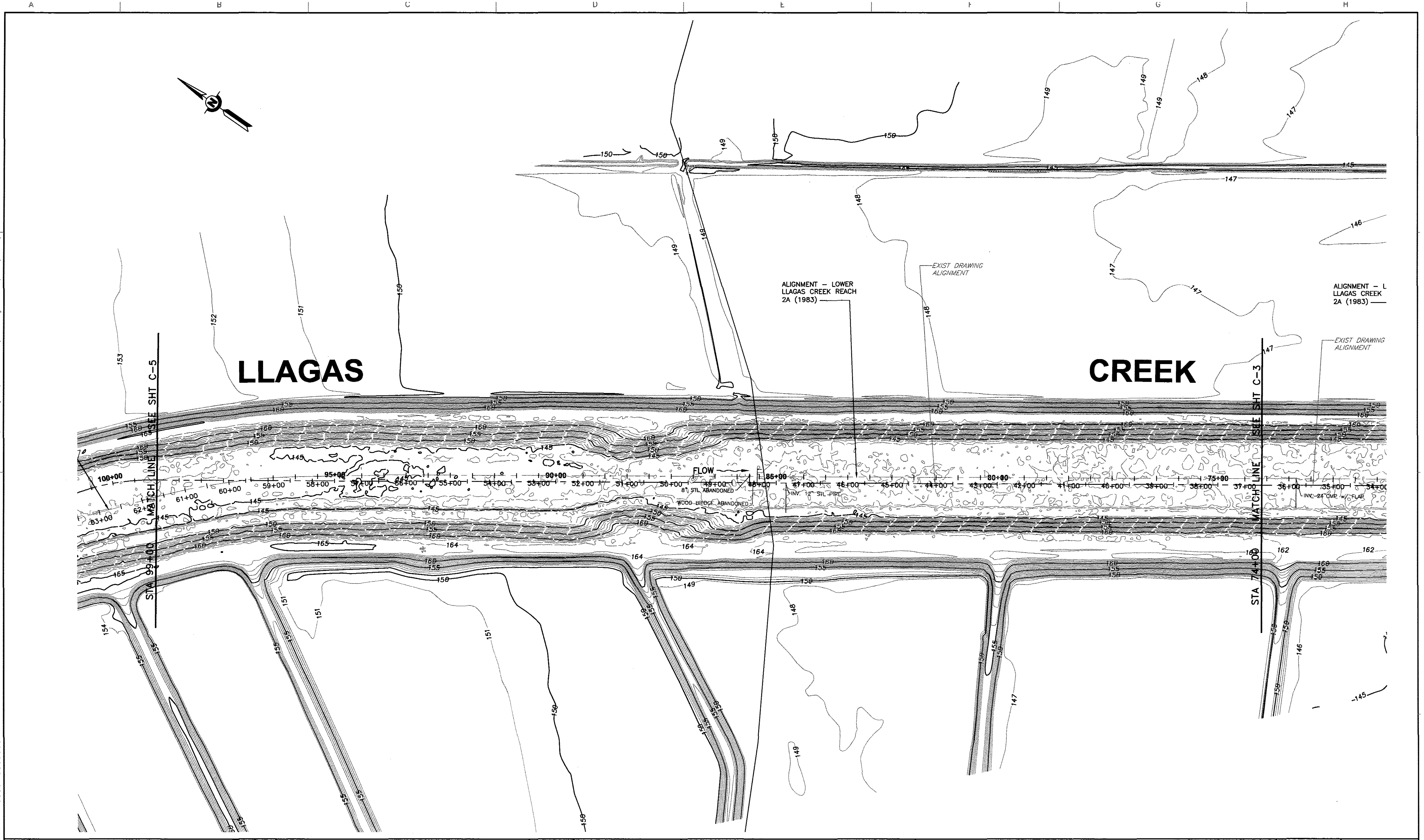

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SHEET CODE:
C-4

PAGE NUMBER:
4 OF 7

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

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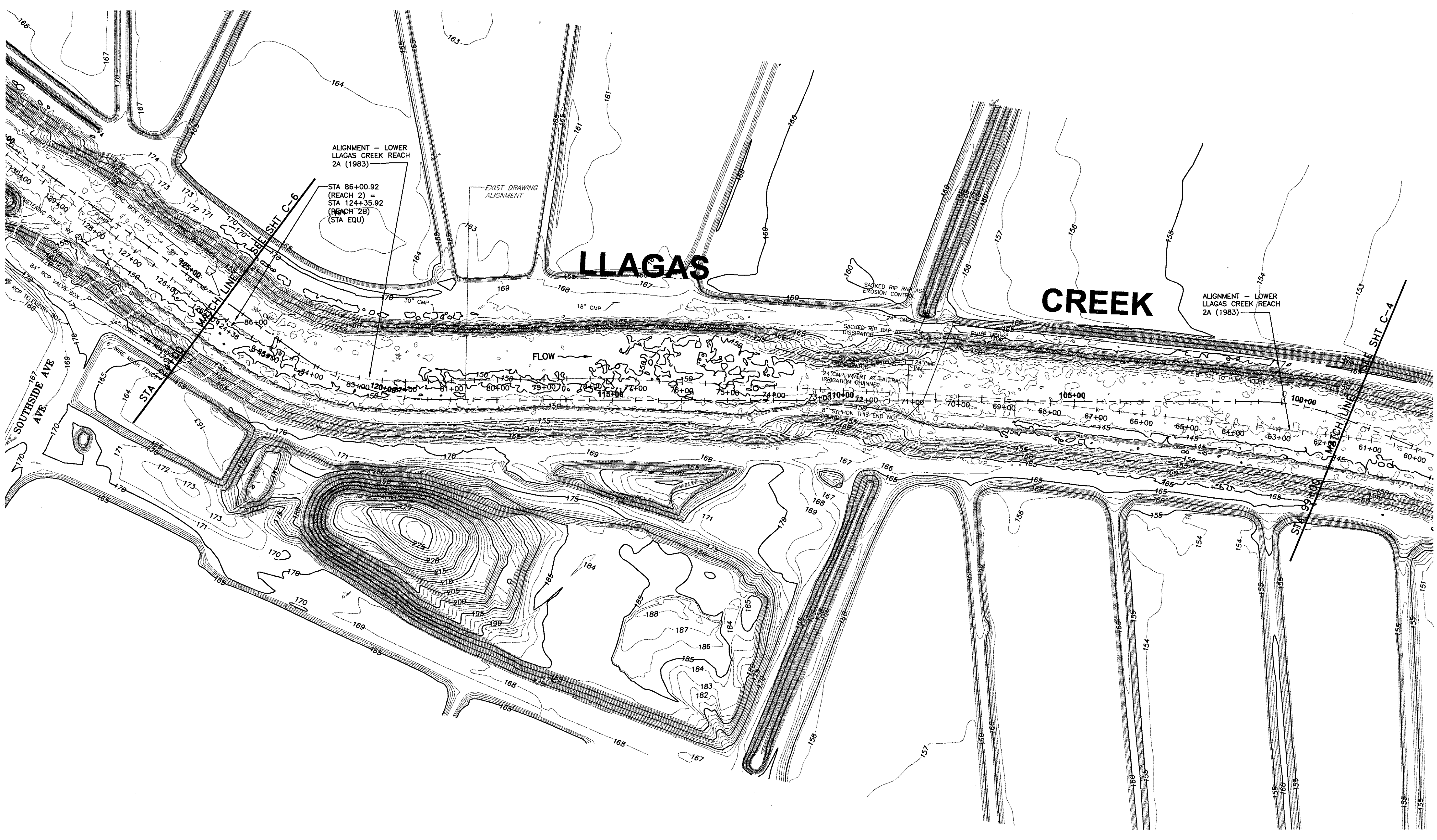

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PLAN
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SCALE
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PROJECT NUMBER
50284010

SHEET CODE:
C-5

PAGE NUMBER:
5 OF 7

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

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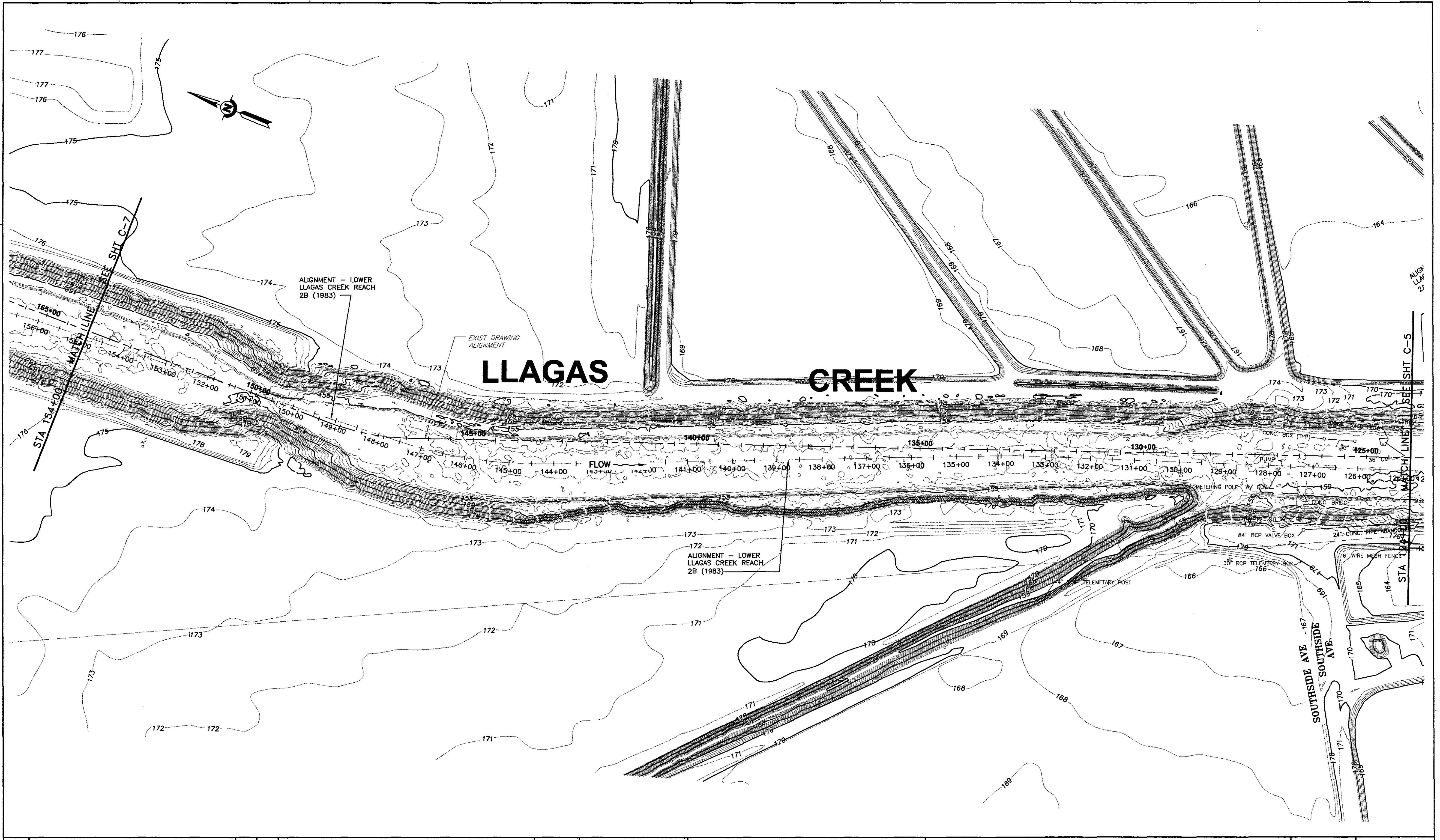

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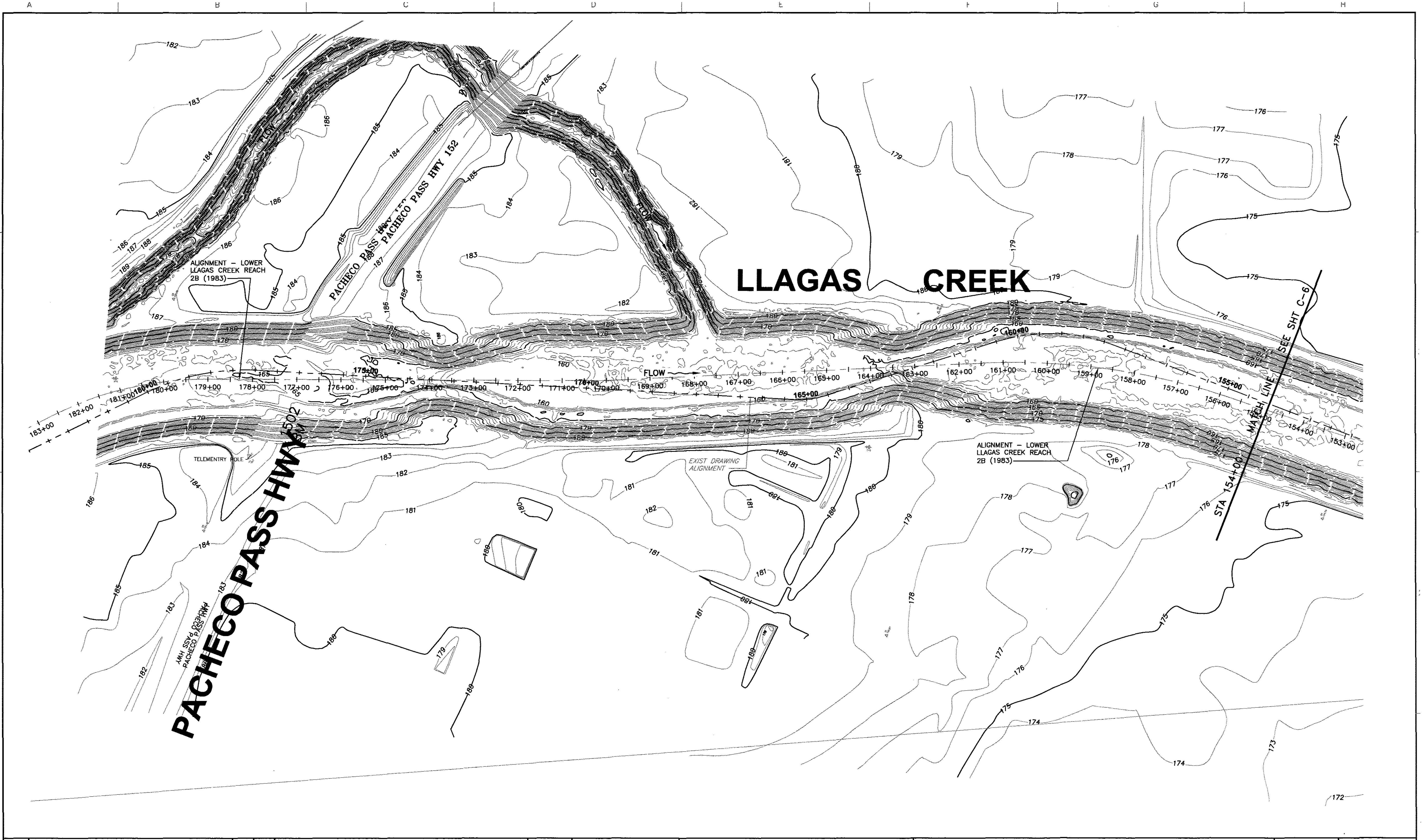
50284010
SHEET CODE:
C-6
PAGE NUMBER:
6 OF 7

DOCUMENT NUMBER: XXXX-X-0000-0000000.00



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LOWER LLAGAS
CAPACITY RESTORATION PROJECT

PLAN
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SCALE
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VERIFY SCALES
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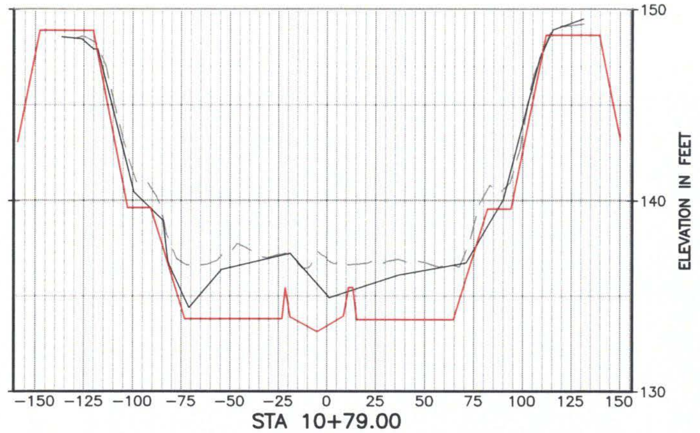
50284010

SHEET CODE:
C-7

PAGE NUMBER:
7 OF 7

APPENDIX G

Existing Conditions Cross-Sections



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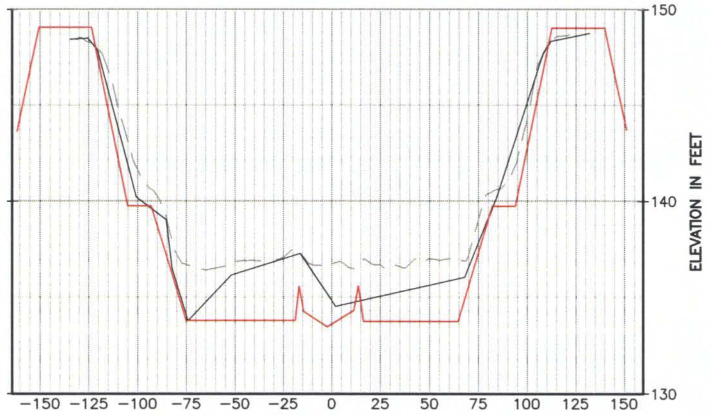

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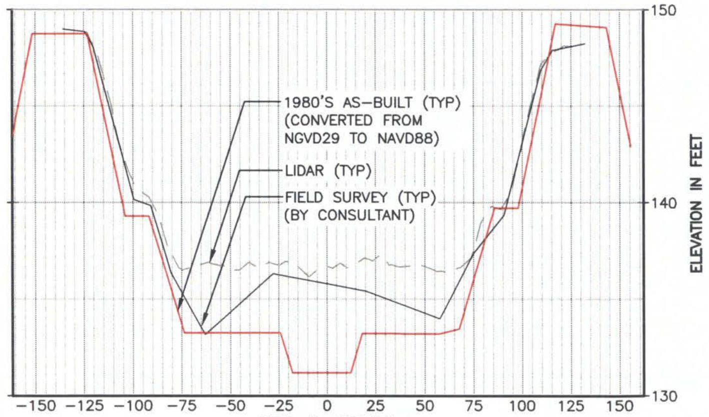

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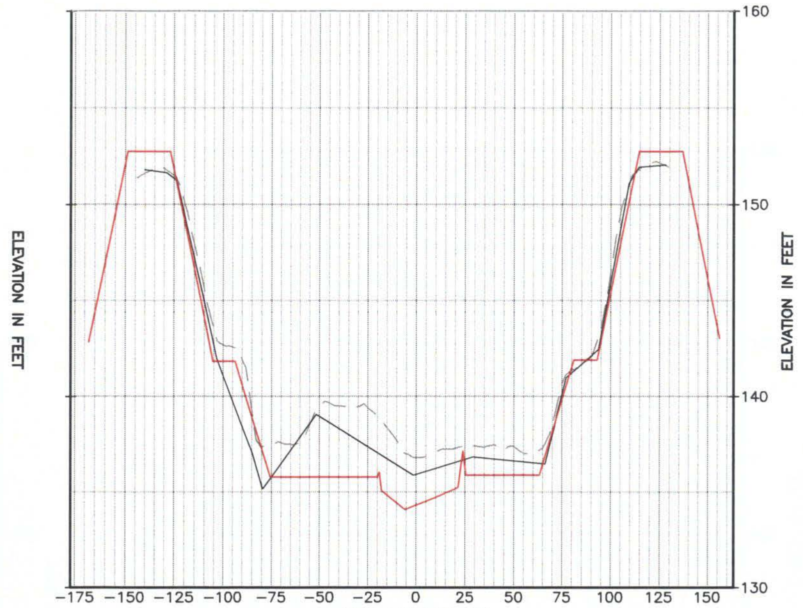

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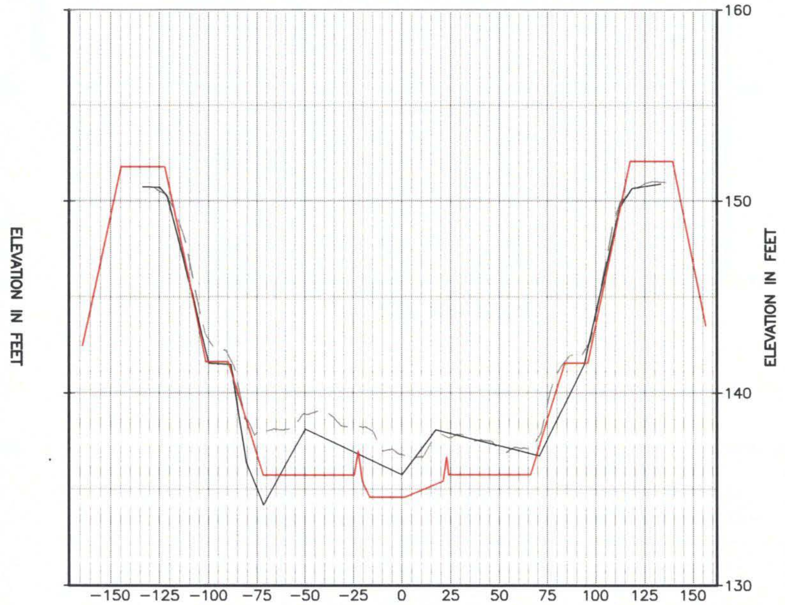

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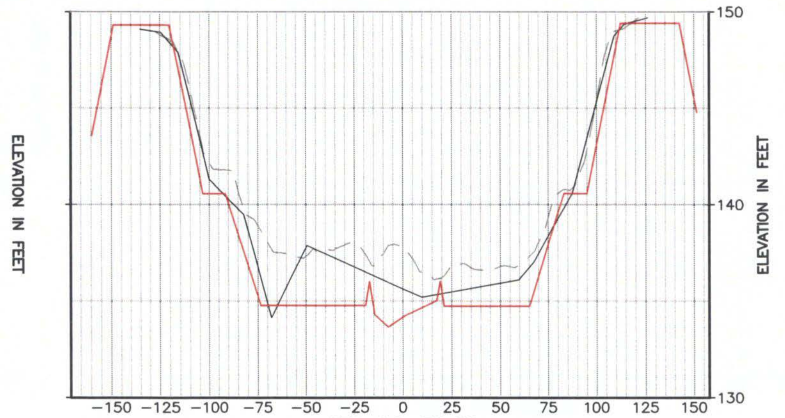

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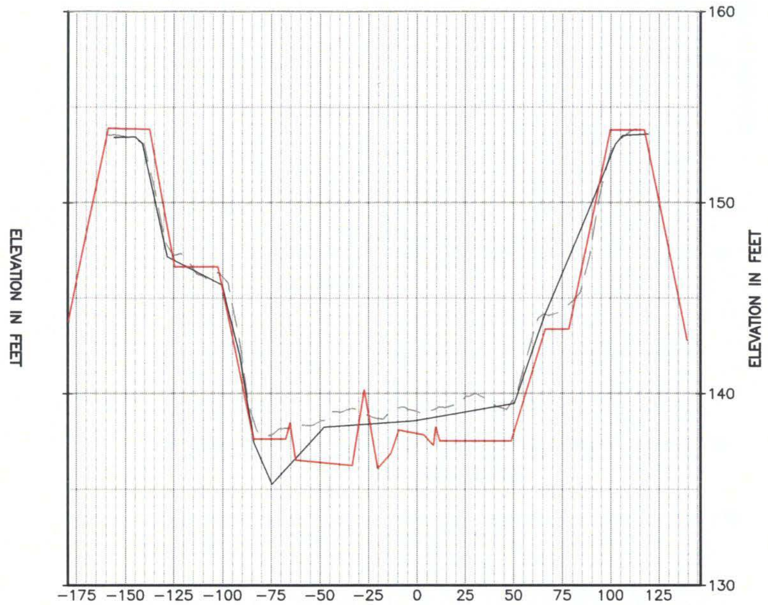

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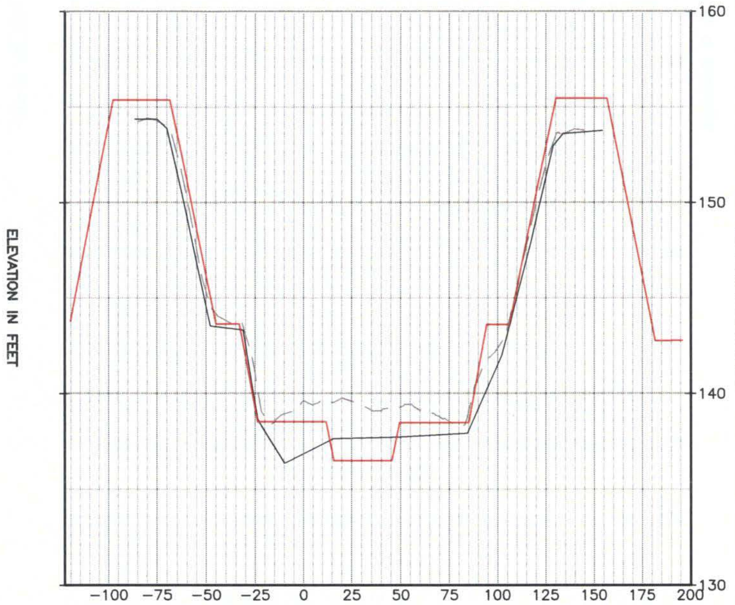

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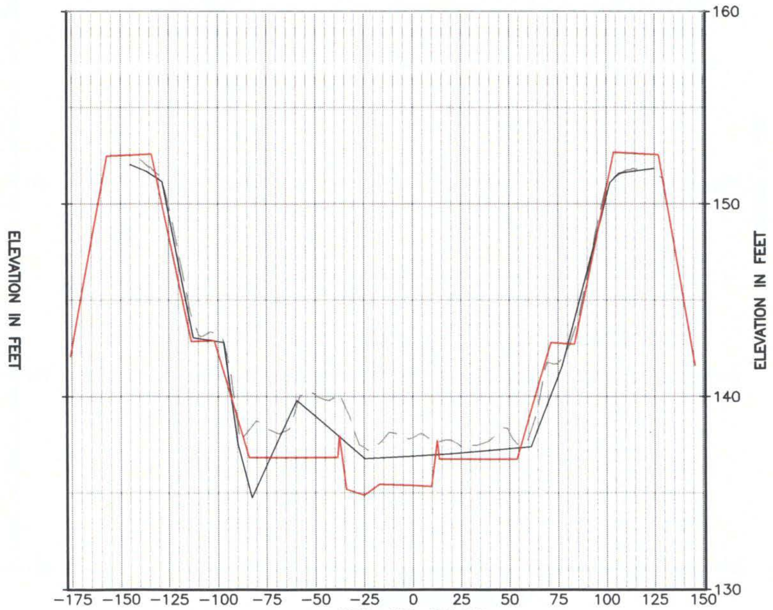

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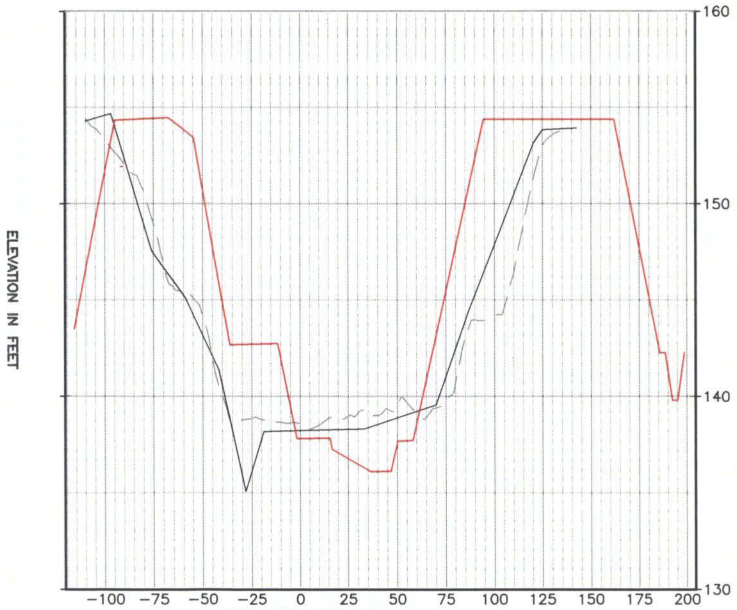

STA 48+19.00

ALL SECTIONS VIEWED LOOKING UPSTREAM

USERNAME: chrichun Thu 03 Sep 2009 10:03am
FILENAME: K:\Active Projects\MP-50284010\Lower Llagas Crk Cap Res\Sheets\X-01

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AUG 2009
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C. CHUNG
DRAWN
R. AGREDA
CHECKED
X.X.X.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

LOWER LLAGAS
CAPACITY RESTORATION PROJECT

CROSS–SECTIONS

SCALE
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V: 1"=5'

VERIFY SCALES
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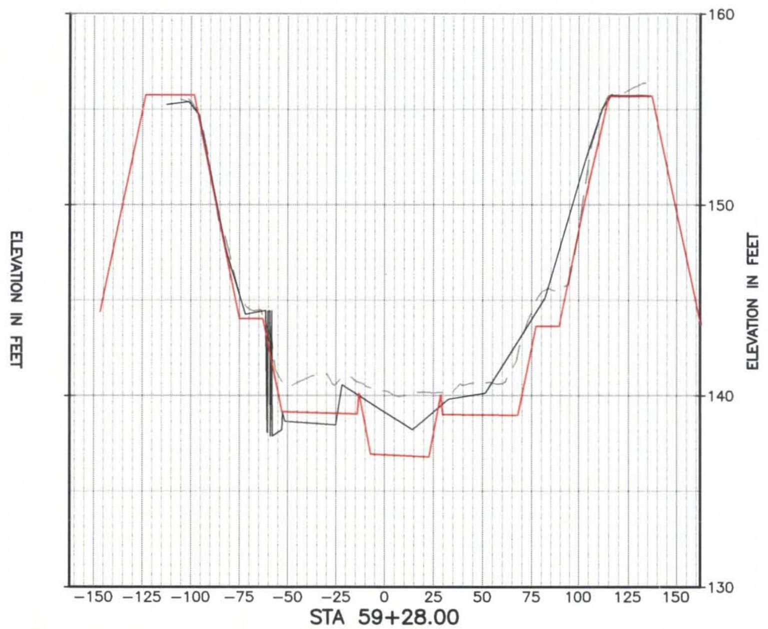
PROJECT NUMBER
50284010

SHEET CODE:
X–1

PAGE NUMBER:
1 OF 7



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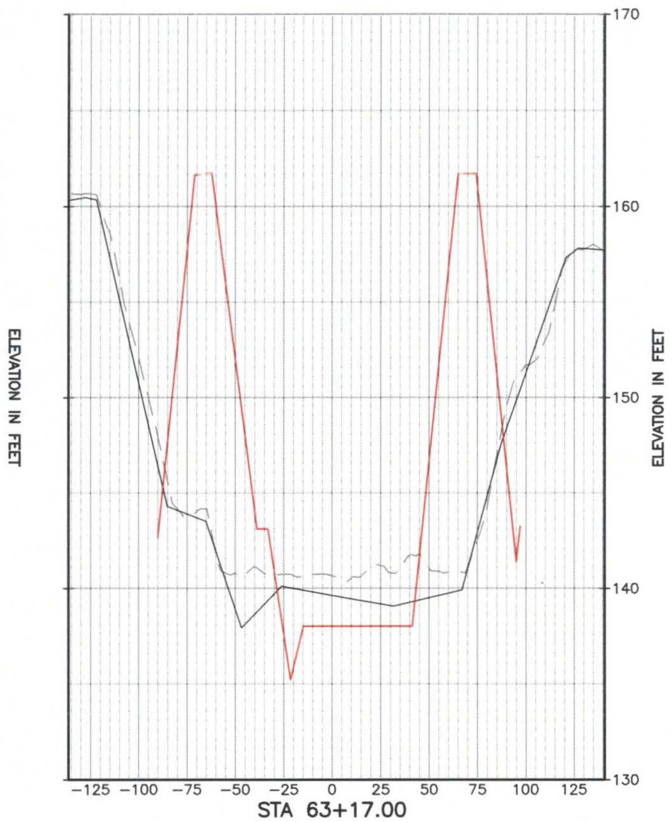

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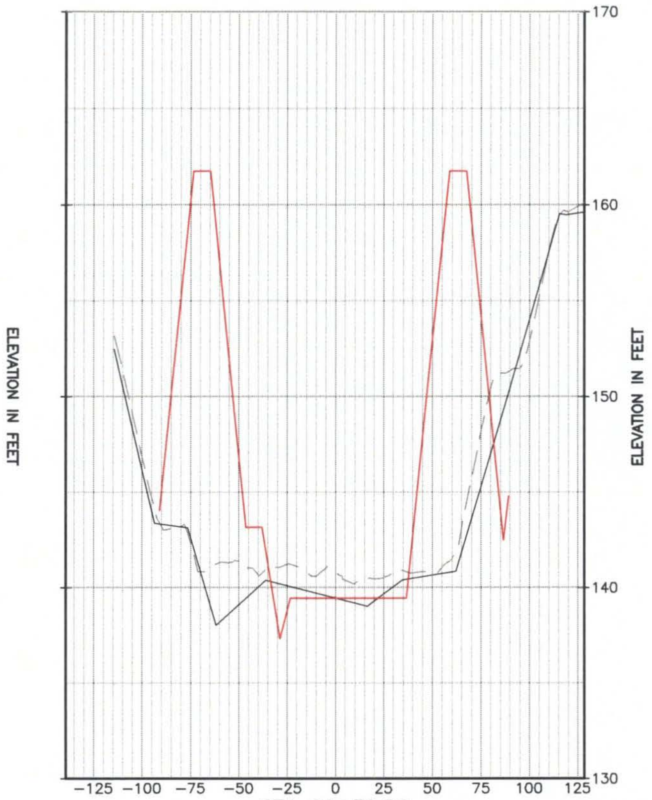

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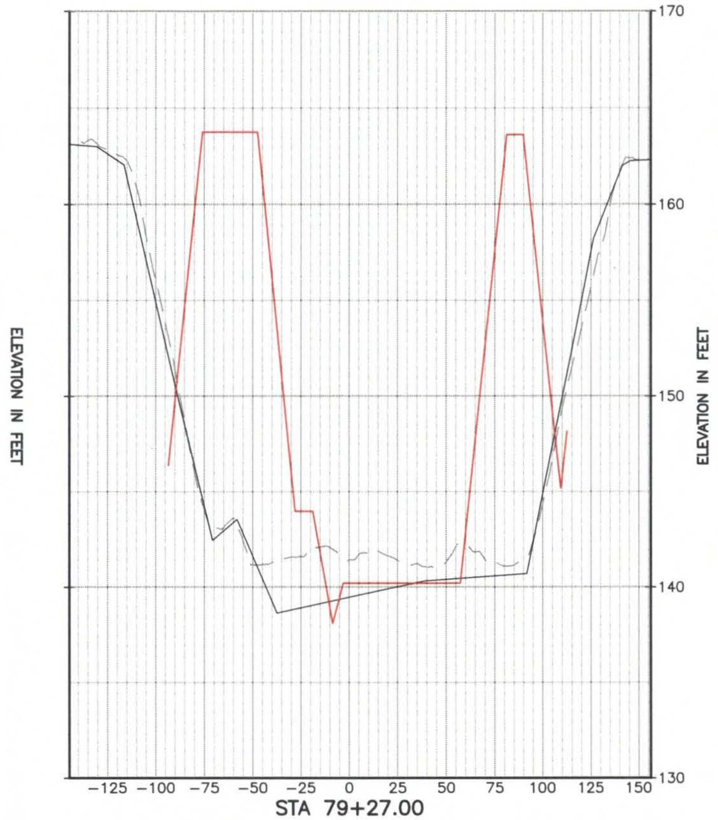

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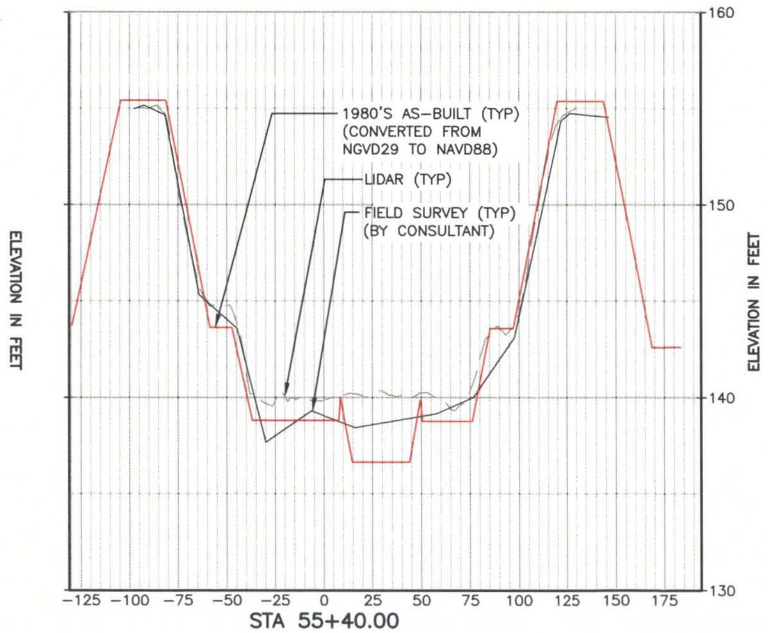

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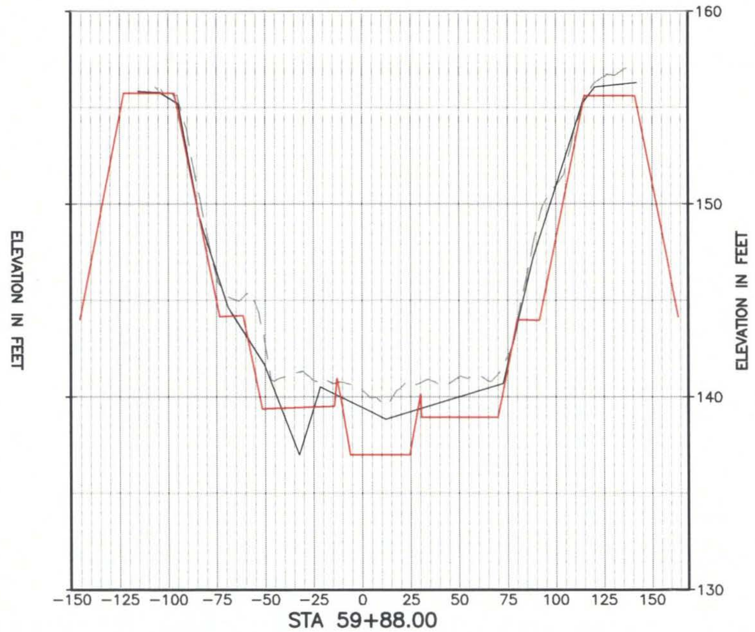

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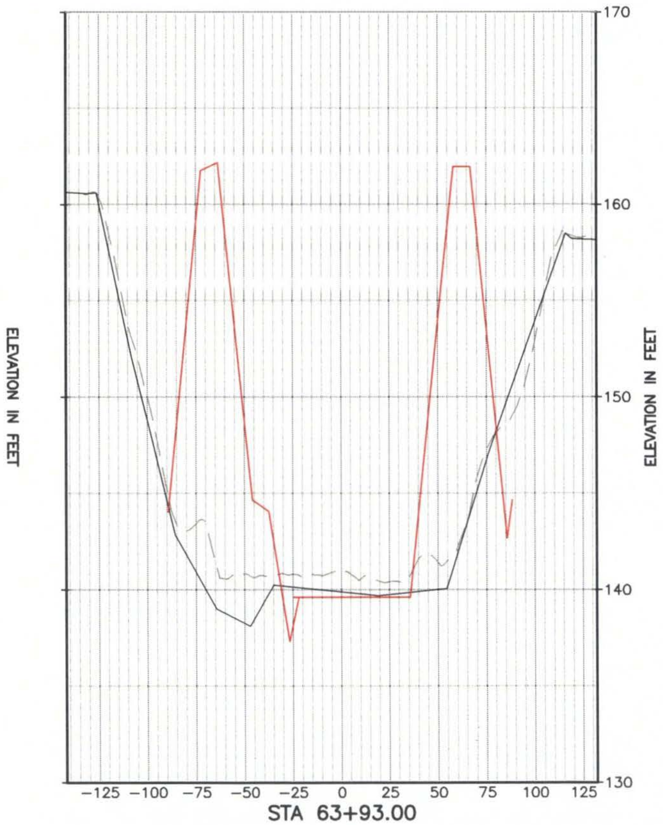

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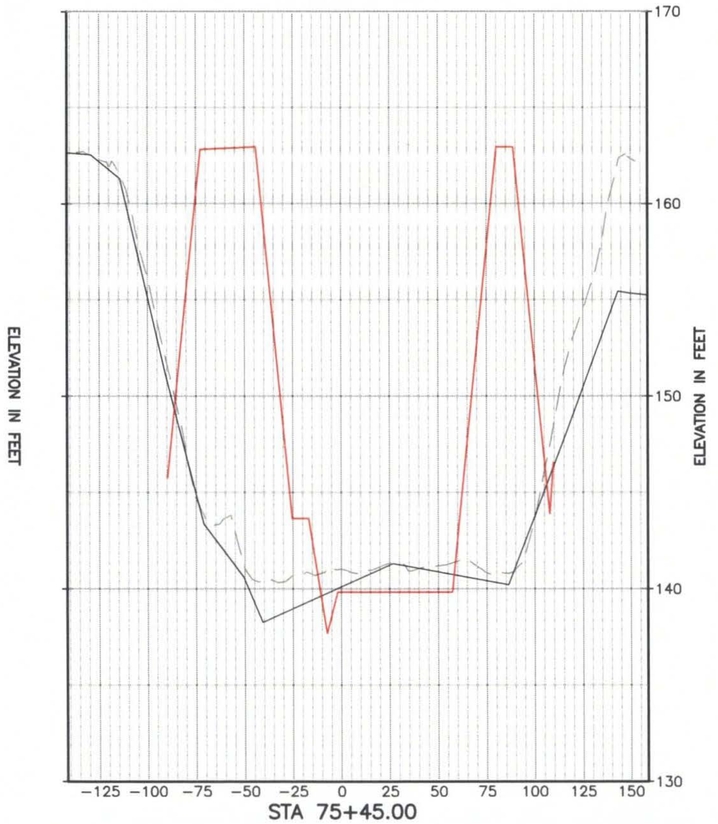

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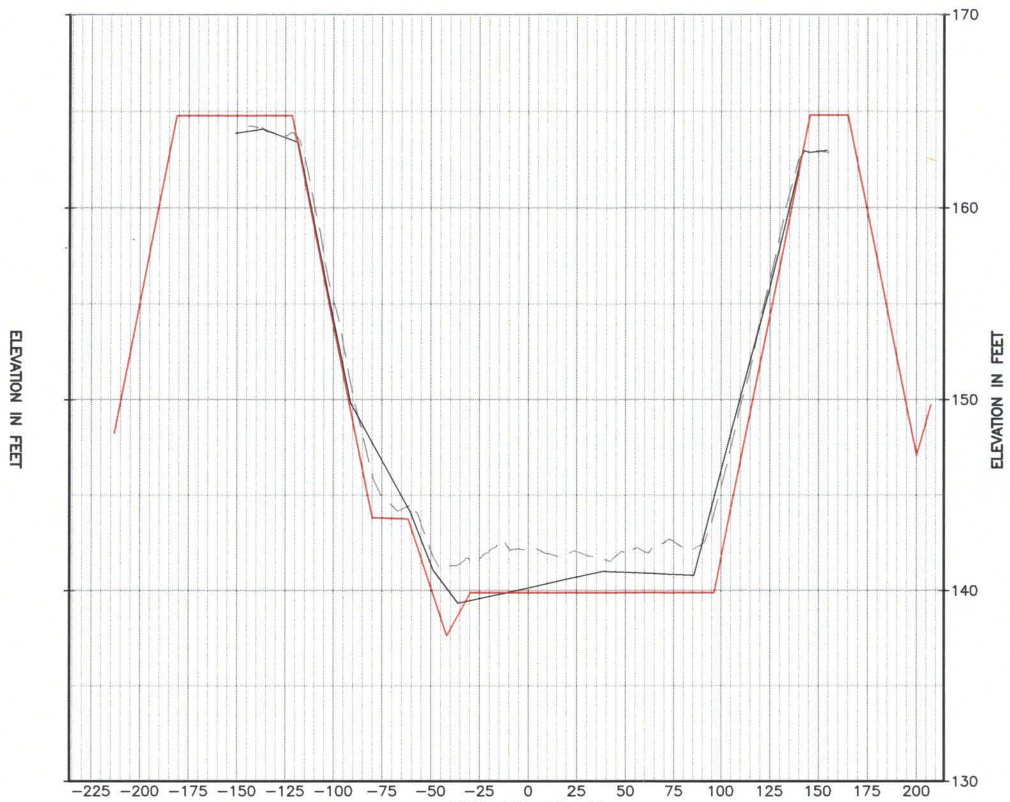

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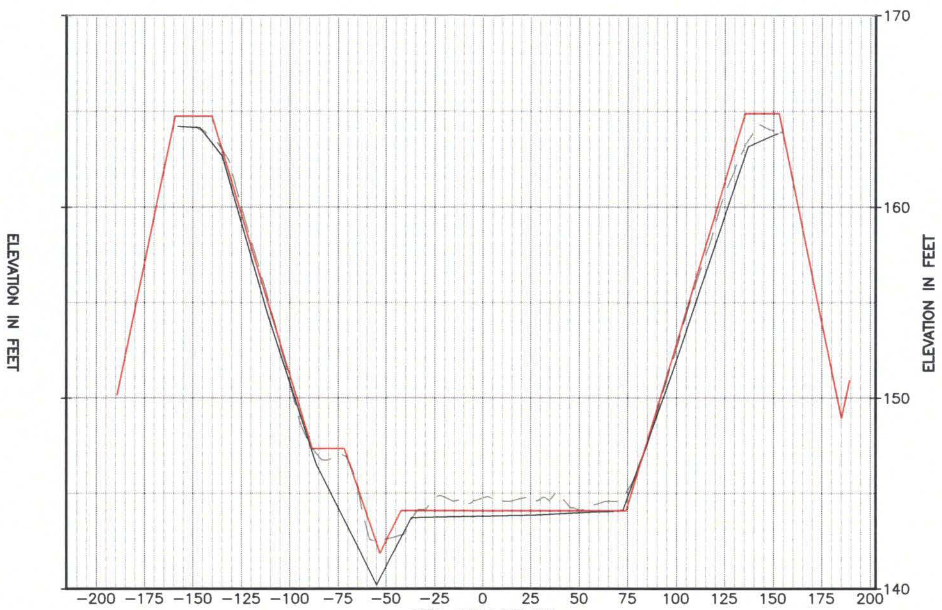

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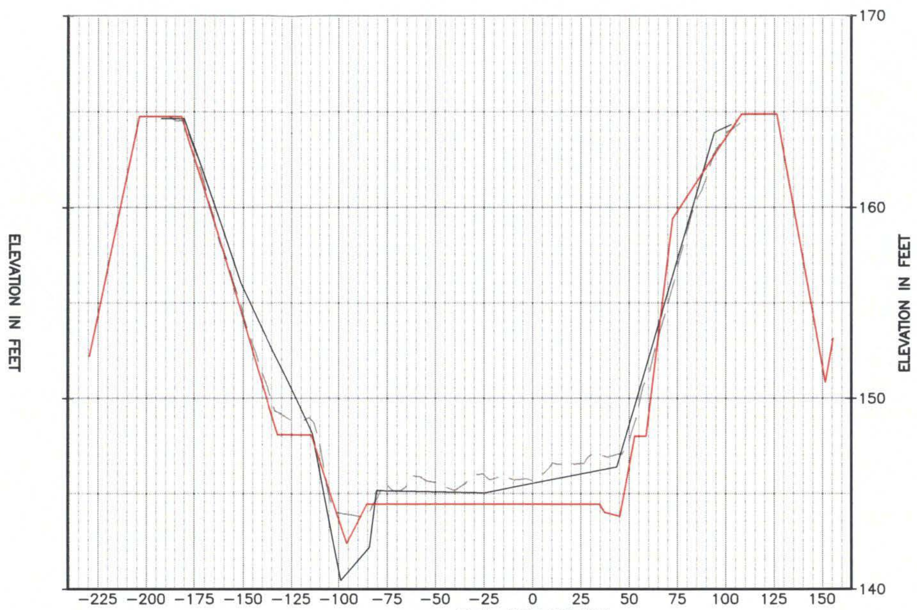

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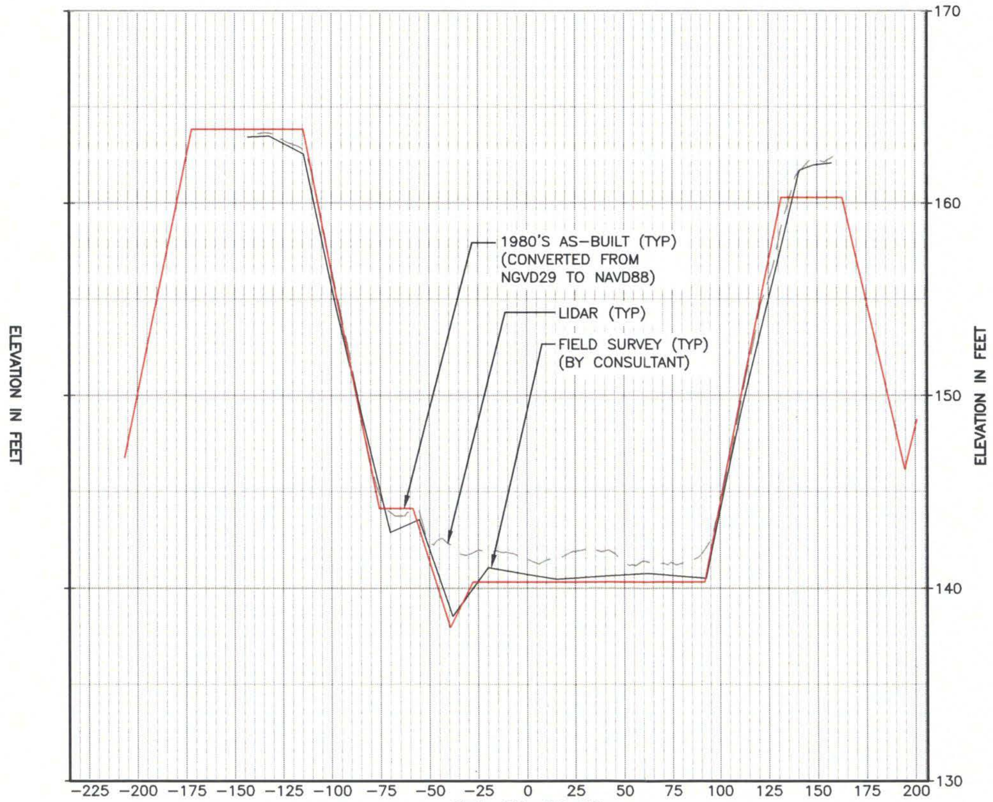

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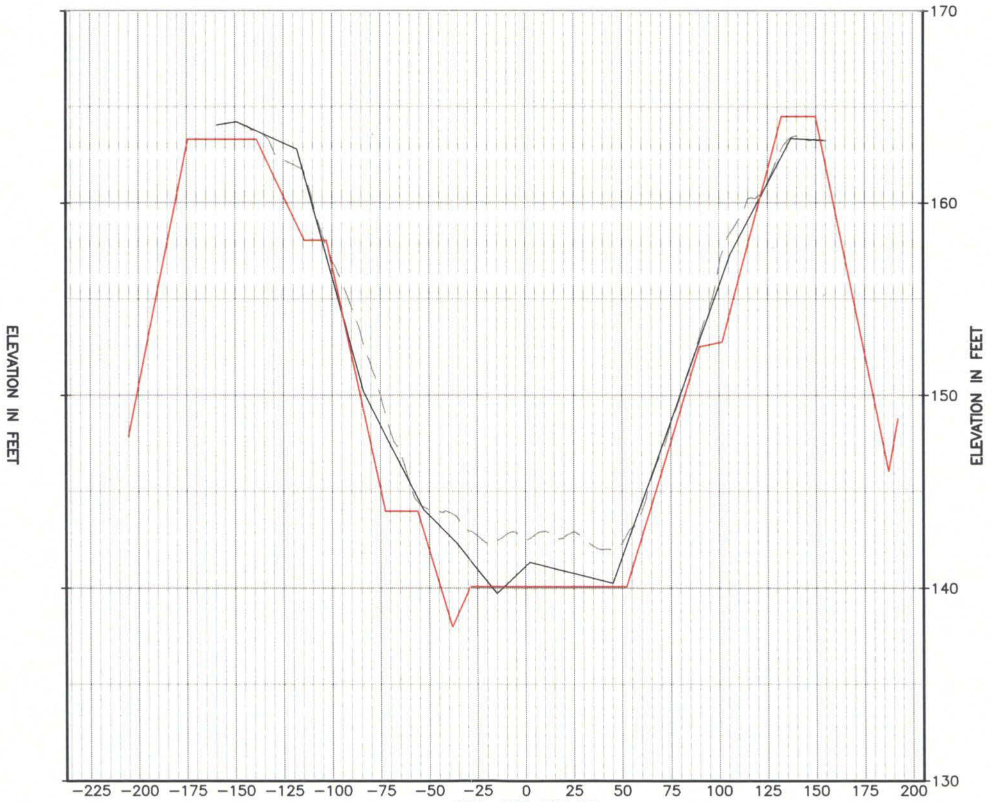

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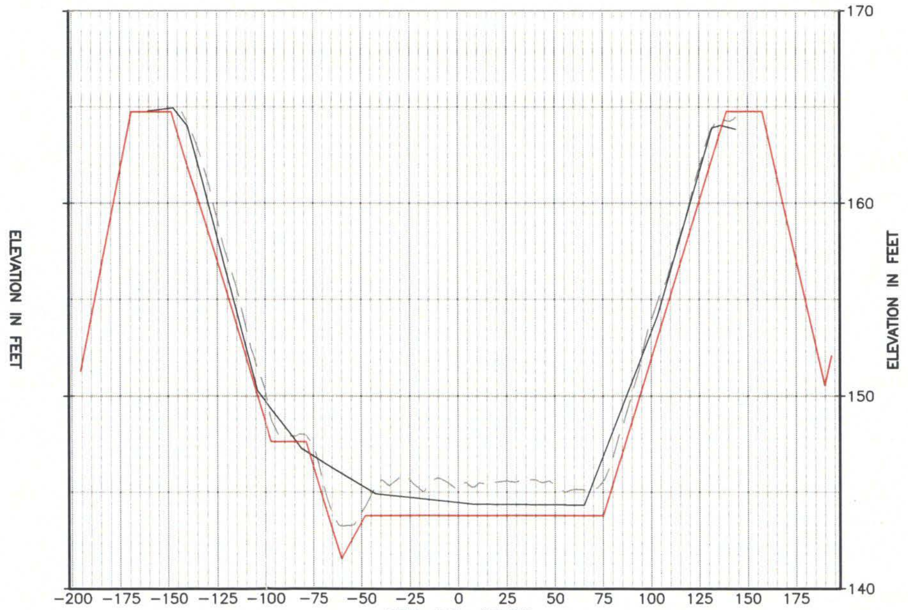

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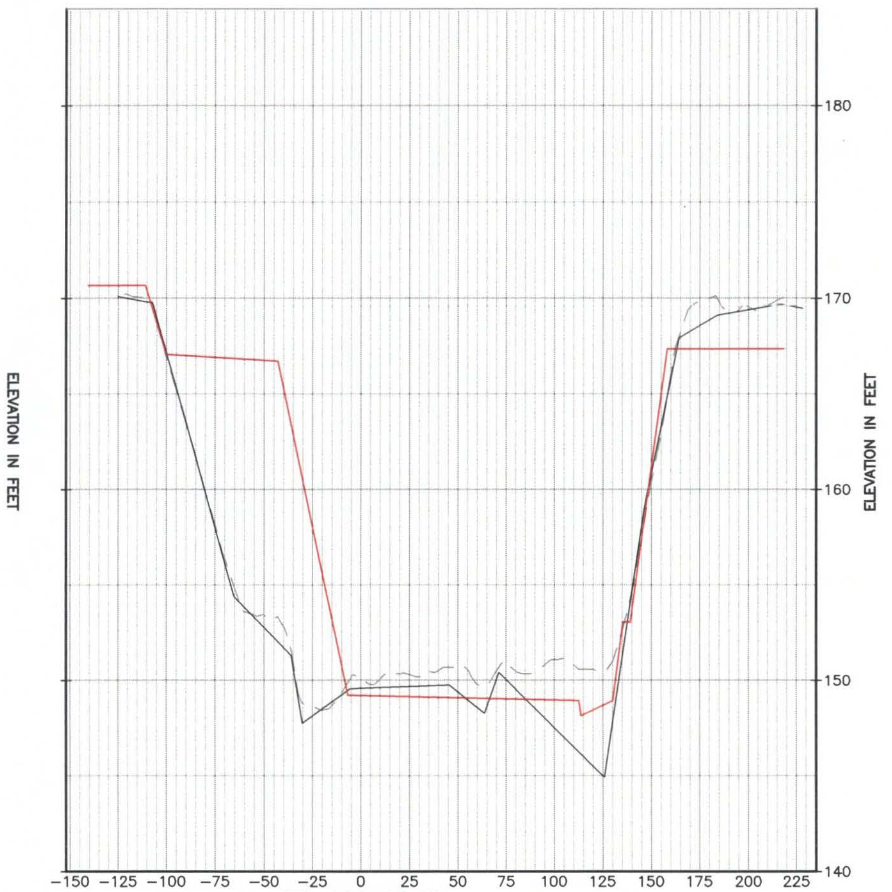

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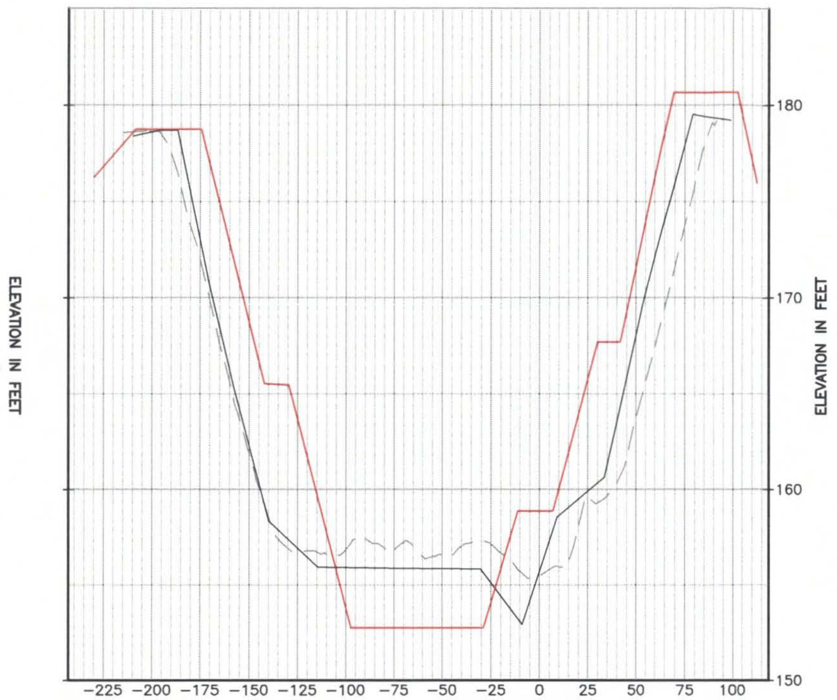

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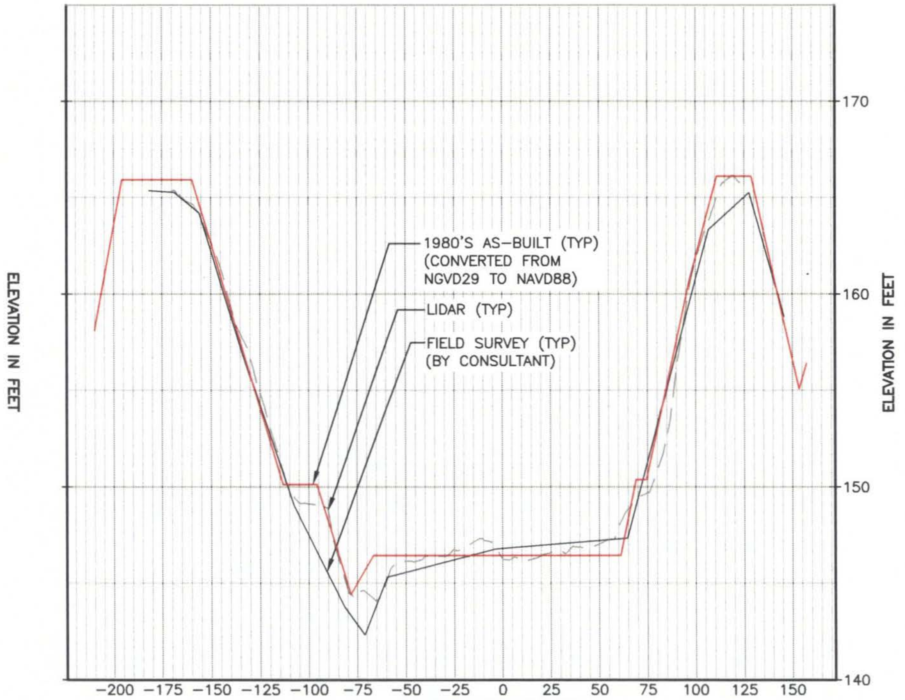

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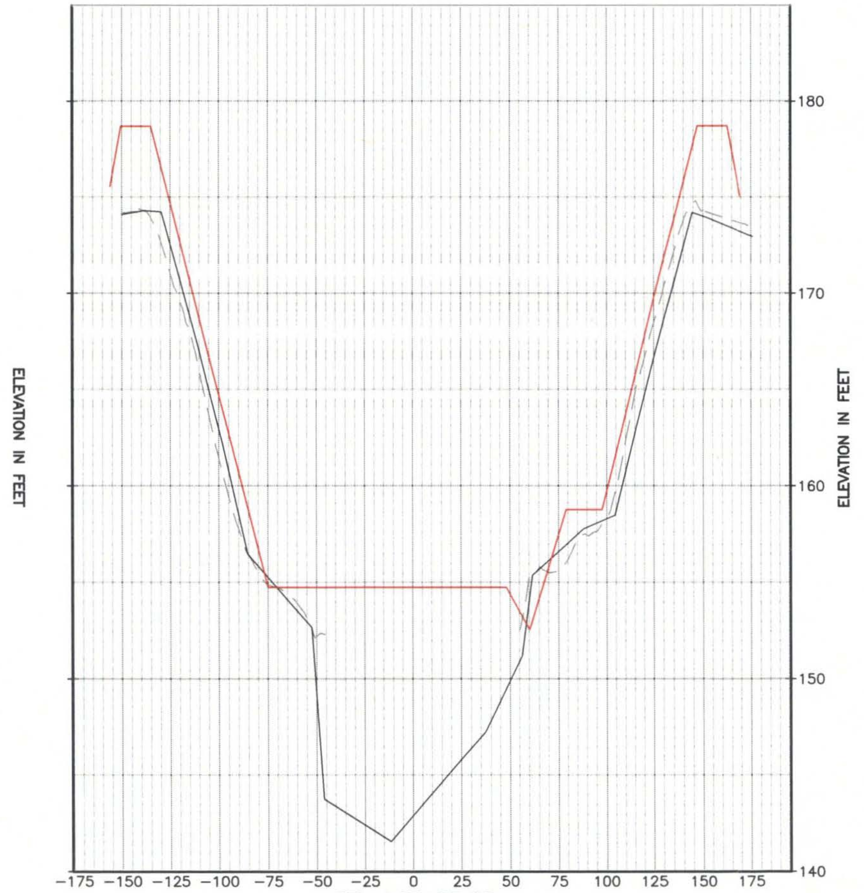

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4 OF 7

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APPENDIX H

Technical Terms and Acronyms

LIST OF TECHNICAL TERMS AND ACRONYMS

hydromodification	channelization
LiDAR	Light Detection and Ranging. A remote sensing technology that uses lasers to determine distance to an object. One application of LiDAR is to collect topographic data.
MCL	Maximum Contaminant Level
MUN	Municipal and Domestic Supply
REC	Recognized Environmental Conditions. RECs are defined by the American Society for Testing and Materials (ASTM) as "the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substance or petroleum products into structures on the property, or into the ground, ground water or surface water of the property."
SCS	Soil Conservation Service
SCRWA	South County Regional Wastewater Authority
SFEI	San Francisco Estuary Institute
TMDL	Total Maximum Daily Load. A TMDL is the pollutant loading capacity that a water body can accept while protecting beneficial uses. Usually, TMDLs are expressed as loads (mass of pollutant calculated from concentration multiplied by the volumetric flow rate), but in the case of fecal coliform, it is more logical for TMDLs to be based on concentration. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures [40 CFR §130.2(I)].
watershed	The geographical region or area drained by a stream. Also referred to as a drainage basin or tributary.